

May 13, 1957

50 Cents

# AVIATION WEEK

A MCGRAW-HILL  
PUBLICATION

T2J Designed as  
All-Phases Trainer

•

CAB's Report on  
Canyon Collision

Lacrosse Surface-to-Surface Missile



# THE HUSTLER

*hustles*



## ON MAIN WHEELS AND BRAKES

*3/Goodyear!*

Main wheels and brakes for the Convair F-58—designed, engineered and produced by Goodyear Aviation Products to meet this foremost jet bomber's space, speed and load requirements.

For information on advanced wheel and brake engineering, write: Goodyear Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.



Probably the most exact even built for its rolling dimension, it's of forged magnesium by Goodyear—meters and tons, zero weight, zero waste space losses.



Number 1 materials know are the key to the better ability of the F-58. Nonmetallic-type lining allows up to 20% increase of kinetic energy absorption per pound of brake.



More strength the world ever had on Goodyear Tires, Wheels and Brakes than on any other brand!

*he's watching the progress of the Air Age from his machine...*



Piston engines... jets... and now, satellites. Foote Bros. craftsmen are watching the steady advance of American air progress from their machines. They're not only watching it—they are an important part of it, because, at this moment they are helping produce components capable of performance undreamed of a short time ago.

At Foote Bros., yesterday's technology, methods and standards of precision are obsolete. Today, these men are working with new metals in new ways, with greater precision, to produce lighter, stronger and more reliable gearing, power transmission and actuating mechanisms for the air age of tomorrow.

It is the willingness to innovate, the ability to anticipate, and the determination to excel that have helped Foote Bros. engineers and production men keep pace with, and earn the confidence of, the aviation industry.

We may be able to help solve your problems in locating precision grinding and retreating mechanisms, and would welcome the opportunity of talking with you.

*No trademark stands for the Best Industrial Gearing made*



## FOOTE BROS.

*Quality Flow Through Grinding Through Cutting Great*

FOOTE BROS. GEAR AND MACHINE CORPORATION  
4842 South Western Boulevard CHICAGO 9, ILLINOIS

*the world's largest manufacturing facilities for aircraft seating ... for aircraft interior equipment.*

## THE SEAT\* OF THE INDUSTRY IS WEBER

*For your requirements in aircraft passenger and crew seats, buffers and lavatories... a very specialized manufacturing capability is demanded. In all the world there is only one such Single Source, having the complete facilities... the full design staff... the exp. stability and strength... the after-sale service standards... and the know.*

*That Single Source... is Weber. So fast take your requirements to the seat of modern aviation seating ... Weber.*

*A field of experience in Passenger seats, Pilot and Crew Seats, Buffers, lavatory seats and lavatory (crotch) interior equipment.*

"SEAT" "The place where anything is seated or installed"  
— Webster Dictionary

**WEBER AIRCRAFT CORPORATION**  
a subsidiary of B. F. Goodrich and Feltzer Company, Inc.  
3020 ONTARIO STREET, BUREAU, CALIFORNIA

### AVIATION CALENDAR

May 13-14—**What the Rucker and Munnig Programs Mean to the Chemical Industry**, Spring Meeting, Commercial Chemical Development Ass., Beach, Calif. and May 15-17—**National Conference on Avionics Electronics**, Sponsored by the Institute of Radio Engineers, Dayton, Ohio.

May 16—**Engine Overhaul & Maintenance Forum**, sponsored by Ford & Whittory Aircraft Division and the former, Pacific American Corp., Comstock Hotel, Denver, Colo. 10am session, May 17 at Alessandro Hotel, Berkeley, Calif., May 20 at Hotel Claremont, Oakland, Calif., and May 21, New Washington Hotel, Seattle, Wash.

May 18-17—**Jet Age Airport Conference**, Air Transport Division, American Society of Civil Engineers, Park Sheraton Hotel, New York.

May 20—**Annual Meeting and read of Daniel Guggenheim Medal**, Aeronautics Club, 1 W. 14 St., New York.

May 22—**Smith Award Aviation Fire Safety Seminar**, National Fire Protection Ass., Hotel Statler, Los Angeles, Calif.

May 23-24—**HTT Design Engineering Conference**, American Society of Mechanical Engineers, Cokenton, New York.

May 25—**Charles Lewis Mansfield Lecture**, Program and Projects of Radio Station, Mayor Dr David Mills Chester Box, New England Mutual Bldg, Boston, Mass.

May 24-26—**2-12nd Fair Air Show Society of French Aircraft Constructors**, LeHarvey Airport, Paris.

May 25-26—**National Advertising Conference**, Hotel Concord, El Paso, Tex.

May 26-27—**Annual Business Aircraft Safety Seminar**, sponsored by Flight Safety Foundation, Park Sheraton Hotel, New York.

May 26-28—**2-Week National Civilian Meet**, sponsored by Society of Civilian Drivers, One Memorial Avenue, Detroit.

June 1-10th—**Annual Maintenance and Operations Meeting for Business and IV** (Continued on page 6)

### AVIATION WEEK ■ MAY 15, 1957

Vol. 86, No. 17

Published weekly with an additional issue in September and December. Circulation 10,000. Published by the Aviation Week Group, Inc., 1230 Avenue of the Americas, New York 20, N. Y. Telephone: MU 2-6000. Second-class postage paid at New York, N. Y., and at additional mailing offices. Postmaster: Please send address changes in New York, N. Y., to Aviation Week, Inc., 1230 Avenue of the Americas, New York 20, N. Y. Outside New York, N. Y., to Aviation Week, Inc., P. O. Box 518, Hightstown, N. J. Single copies 15¢. Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢. Second-class postage paid at Hightstown, N. J., and at additional mailing offices. Postmaster: Please send address changes in Hightstown, N. J., to Aviation Week, Inc., P. O. Box 518, Hightstown, N. J. Outside Hightstown, N. J., to Aviation Week, Inc., P. O. Box 518, Hightstown, N. J. Single copies 20¢. Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.

Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.

Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.

Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.

Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.

Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.

Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.

Subscription price for one year (12 issues) \$12.00 in advance. Payment in advance. All rates include postage. Payment in U. S. dollars only. Foreign rates \$15.00 per year. Single copies 20¢.



**no cloud above  
no earth below**

**... a universe of sky and GO!**

Advanced analysis and testing new trials in the experience of other space ... and precision components help determine the success of their high speed, high altitude course.

Experience, skilled personnel and modern facilities at Lavelle are focused on the precision fabrication of blades, engine, airframe, and electronic components in titanium, aluminum, stainless steel and other heat resistant, high strength alloys ... to the most exact specifications.

Rear jet engine cases and diffuser sections, fuel manifolds, flame holders, combustion chambers and liners are typical components made by Lavelle for major manufacturers. They rely on Lavelle's quality workmanship, dependable delivery and reasonable costs.

Where your production standards demand only the finest in reliable components ... contact Lavelle!

Write for illustrated brochure describing Lavelle's services in detail.





## New VAN TRAILER by Craig houses all this equipment . . . with room to spare!

That's plenty of room inside the new modified Craig Van Trailer LM-1011 built in its 7,000 gross payload and roomy 375 cubic foot interior, this rugged van trailer can house 15 standard 4 foot racks, fully loaded with electronic equipment — and still allow ample space for operation and maintenance.

Whatever the load — a complete electronic system, test equipment, mobile maintenance shop, or power-line or — your equipment travels quickly and safely in the LM-1011. This versatile van trailer meets Government specifications for mobile-able, all-weather use.

### Quick facts about the LM-1011:

**WEIGHT:** Approximately 4,000 pounds including daily.

**PAYLOAD:** 7,000 pounds

**EXTERIOR:** (Length) 143 inches long, 70 inches wide, 70 inches high.

**INSULATION:** overall double line U-Termix at 0.35

**FEATURES INCLUDE:** a's maximum-load honeycomb panel construction, lighting system, power distribution bus, cable tray, spare parts racks for tools, and a quickly detachable utility with 400 amp and reserve bar suspension, an emergency brake, and single beam towing tongue.

**ACCESSORY EQUIPMENT AVAILABLE:** includes air conditioning, heater, water tanks, seats, tables, spare parts containers, etc.

For further information, write Craig Inc.!

**Craig SYSTEMS, INC.** Dept. N-5, Danvers, Mass. Tel: 879-4700

WESTERN DIVISION: 6214 15th Member Avenue, San Diego, 44, California 92121

**OTHER CRAIG PRODUCTS . . .** transportable and mobile electronic systems, shelters, trailers, vans, mobile control houses, mobile control, mobile maintenance, vehicle repair and more.

**AW TRANSPORTABLE:** By C-119 or larger cargo aircraft.

**ELECTRONIC INSTALLATION:** Craig provides complete layout and installation of equipment including wiring and component checkout.



The Trailer LM-1011, front view, with hook on trailer.

## AVIATION CALENDAR

(Continued from page 1)

- 2024: Aircraft Division, awarded by Boeing, Aviation Service, Reading, Mass. report, Pa.
- June 13—First General Aviation Law Seminar, Wichita University, Kans.
- June 4—Symposium on Materials for Electronic Components, University of New Orleans, Louisiana, La.
- June 13—National Symposium on Electronic Foundation Techniques, D'Arcy Hotel, Washington, D. C.
- June 5—11—Technical Personnel Supporting Symposium on cooperation with National Technical Career Conference, Sheraton Hotel, Chicago, Ill.
- June 14—15th Annual Meeting, American Society of Mechanical Engineers, Sheraton Hotel, San Francisco, Calif.
- June 19—19—Lecture Series on Vacuum Metallurgy, sponsored by New York University College of Engineering, address to given by Dr. H. F. Dondak, N. Y. University College of Engineering, University Heights, N. Y.
- June 13—13th Western Plant Maintenance & Engineering Conference, Civic Auditorium, San Francisco, Calif.
- June 14—Forum on Electronics, New England Society of Plastics Engineers, Lowell Technological Institute, Lowell, Mass.
- June 17—17—National Conference on Military Electronics, Sheraton Park Hotel, Washington, D. C., sponsored by Institute of Aeronautics.
- June 17—18—English VI Weapons Interest Group, San Jose, Calif., San Jose State University, San Jose, Calif.
- June 17—18—National Seminar, Victoria, in vicinity of the Northwest Science Hill, Sheraton Hotel, Los Angeles, Calif.
- June 15—15th Annual Meeting, Aviation Technicians & Administrators Assn., The Broadmoor, Colorado Springs, Colo.
- June 24—1967 National Aviation Day, Yakima.
- June 25—15th Annual Meeting, Institute of Navigation, Sheraton Park Hotel, Washington, D. C.
- July 6—6—General All-Weather Transients, held by Aero, from San Ysidro Convocation Center, Calif., in North Platte, Neb. report, Pa.
- July 30—30—International British Electric Light Conference, London, Great Britain, Royal Hotel, England.
- July 12—12—Solid Fuelled Jet Propulsion Institute Conference, the National Aero and Space Board (read) and the Space City Air Base, Coventry Civil Aerodrome, Coventry, England.
- July 14—14—1967th Annual National Conference for Electronic and Test Power Personnel, Sheraton Park and Statler Hotel, Washington, D. C.
- Aug. 18—18—49th Annual Electronics Show & Conference, Cow Palace, San Francisco.
- Sept. 16—16th International Astronautical Conference, held in Moscow and vicinity and held by the International Scientific Federation and London, England.
- Sept. 24—24—55th Flying Display, Society of British Aircraft Constructors, Farnborough, England.



## How Holley's Compressor Governors Help New Jets to Supersonic Speeds

"City-overs" Air Force men call them: the F-57-powered F-100, F-101, F-102 and Navy F-111, with fuel flight speeds faster than sound. And city-overs they could well be. Certainly their rapid approach to the fringes of Mach 2 heralds a new era in the progress of jet flight.

Starting in the development of the new breed of supersonic fighters, Holley engineers, working closely with Pratt & Whitney Aircraft on the F-57 engine, designed the compressor bleed governor.

This new Holley compressor bleed governor is one more example of Holley's continuing leadership in the design, development and manufacture of superior engine control systems for both military and civilian use.

Leader in the design, development, and manufacture of superior fuel metering devices.

**HOLLEY**  
Carburetor Co.

1195 L. New Mile Road — Van Dyke, Michigan

# Stroukoff C-134

## The first Pantobase-BLC transport



### SPECIFICATIONS

WING SPAN—75 FT  
 FUSELAGE LENGTH—42 FT  
 CARGO AREA—1075 SQ FT  
 POWERED BY FOUR B-335—534  
 Weight Turbo-compound engine

The stability of military transport aircraft has been extremely improved with the Stroukoff Pantobase and Blemley layer construction. The latter provides a rigid, torsion-resistant structure for a variety of unusual special missions requiring operational stability in the event of conventional wing failure. The Stroukoff C-134 is designed for an important role in modern military strategy.

airframe design has been combined with Stroukoff's Pantobase and Blemley layer construction. The latter provides a rigid, torsion-resistant structure for a variety of unusual special missions requiring operational stability in the event of conventional wing failure. The Stroukoff C-134 is designed for an important role in modern military strategy.

increasing requirements for modified engines in heavy loads over the Stroukoff C-134 with the use of a wing area of 140 square feet in empty. The heavy construction of wings.

### Extending the Frontiers of Aircraft Performance



# Stroukoff

AIRCRAFT CORPORATION  
WEST YERMYON, NEW JERSEY

## EDISON MINIATURE—HI-TEMP

# servo systems and components

The Edison miniature Damos is now offering design engineers an extensive line of miniature and subminiature 50/60 Cycle Servo and Servo Components... in addition to a complete line of custom designed units and servo sub-systems.

Edison's Size 11 Micro Damping Servo for example was built to such precise tolerances that a building systems manufacturer was able to make this package and its drive only in a balanced generator. This miniature unit's fast response and its output speed makes it ideal for applications where weight, size and high performance are prime objectives.

Precision production and rigid quality control inspection have made these "precision" components possible. In addition to these special units, Edison also manufactures an extensive line of standard servo motors and servo sub-generator combinations from size 4... to a quality group of precision, and modern style of magnetic heads for light and precision reading computers.

For information about Edison precision Servo and Servo Components to be for Catalog No. 304  
 ... you copy is required.

### EDISON SERVO MOTOR DAMPING GENERATOR

TYPE OF MOTOR	PHASE LEAD
NO LOAD SPEED (RPM) 1000	MOTOR DAMPING
FULL LOAD SPEED (RPM) 1000	5000
POWER INPUT TO MOTOR AT SMALL	500
100% DUTY	50
OUTPUT AT MAXIMUM OUTPUT (WATT)	2.5
OUTPUT AT MAX. POWER (WATT)	3.000
PERFORMANCE, REGULATING AT SMALL	40-60
PERFORMANCE, REGULATING AT SMALL	PERMANENTLY
TIME CONSTANT	0.15 SEC
POWER INPUT TO GENERATOR AT SMALL	2.5
OUTPUT VOLTAGE AT 100% DUTY (RPM) 1000	0.15
OUTPUT VOLTAGE AT 100% DUTY (RPM) 1000	1.5
OUTPUT VOLTAGE AT 100% DUTY (RPM) 1000	1.5
OUTPUT VOLTAGE AT 100% DUTY (RPM) 1000	1.5



Thomas A. Edison  
INDUSTRIES

EDISONVILLE, PENNSYLVANIA • PHILADELPHIA, PA.



WRITE FOR  
CIRCULARS OF  
THE  
MOTOR UNIT  
SERVO

# ADEL

## "DESIGN SIMPLICITY" FOR PERFORMANCE RELIABILITY

*New Steel Body, Miniature, Solenoid Operated  
Directional Control Valves*



OLD AND NEW VALVES ACTUAL SIZE



### SPECIFICATIONS

Flow Interflow,  
Low Surge Droops  
Types I & II Bys. (-50°F  
to +150°F & +270°F)  
Corrosion Resistant  
Construction

Operating Pressure Range-  
250 to 3000 PSI

Total Pressure Drop-  
60 PSI at Rated Flow

Inletted Lockup-  
10 cc/Min. Max. at 90°F

Solenoids: Continuous  
Duty, Single Dry Coil,  
18 to 28 V dc operation at  
-60°F to +125°F

Current Drain-  
1 Amp Max. at 28 V dc

Performance and  
qualification based upon  
CJ, specification

MIL-D-1626, but suitable  
for other SAEs

Compared with  
similar valves having  
aluminum bodies and  
steel components, these  
new valves provide:

- 1/3 number of seals
- 1/4 number of parts
- 1/2 space requirements
- 1/2 weight

### DESIGNED FOR EXTENSIVE STANDARDIZATION OF PARTS

#### VARIATIONS

- 2 and 3 Position, 4-Way
- 2 and 3 Position, 4-Way with Solenoid Manual  
Override
- 3 Position, 4-Way with Platen Manual Override
- Line Stock: 1/8, 1/4 and 1/2 Inch Ports per ANS  
10050



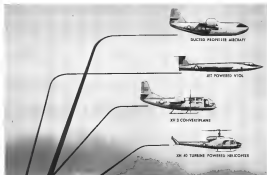
View today for the  
complete product

*Reliability*  
**ADEL** PRECISION  
PRODUCTS  
A DIVISION OF GENERAL MILITE CORPORATION

BURBANK, CALIFORNIA • HUNTINGTON, WEST VIRGINIA

DISTRICT OFFICES: MEMPHIS • DAYTON • WICHITA • DALLAS • TORONTO

Designs, Development, Manufacture and Sales of Hydraulic, Pneumatic, Fuel, Mechanical and Electrical Equipment, and Zero Gravity



# VTOL

...new  
dimensions  
of FLIGHT



Bell Aircraft has kept pace with the need for greater operational mobility and flexibility in both military and commercial aviation by developing four basic types of VTOL (vertical-take-off-and-landing) aircraft.

Studies and development work on a ducted propeller prototype have advanced to a point where this new design concept is fast approaching reality at Bell. The X-14 uses new principles of jet propulsion to take off and land vertically with the airplane in a normal horizontal position. The XV-3 convertible takes off like a helicopter, but as its rotor tips forward in flight, it becomes a normal, fixed wing aircraft. The XV-6 turbopropeller helicopter has substantially increased speed and payload and the ability to use a wide range of fuels.

The skillful and imaginative type of research which was the forerunner of these projects is being carried steadily forward at Bell Aircraft in the interest of still further scientific advancements in the commercial and military aircraft of tomorrow.

RESEARCH, DEVELOPMENT AND PRODUCTION IN THE FIELDS OF: Guided Missiles • Research Aircraft • Servomechanisms • Electronics • Rocket Engines • Electrostatic Control Devices • Vertical Landing Aircraft



# OXYGEN SYSTEMS for

## New Jet Transport Aircraft



Emergency Passenger Oxygen System and Instructions Pack

Always check out the latest in the Scott Line of Oxygen Systems for the Jet Transport Aircraft. Wear the more complete information.



1100 Electronic Oxygen Gauge

Automatic Oxygen System Valve



10000 Oxygen Demand Indicator



Removable Mask with Altitude Indicator

12000 Flow Controller

12000 Flow Controller



## Airline and Executive Aircraft

PLUS

Equipment for each aircraft. Tail wheel assembly. Wheel, Control Tower, Parking Brake valve. Air and Temperature Gauge.



Scan Oxygen Console AV 3



AT200 Oxygen for Airplane Cabin



Removable Mask

Removable Mask



Low cost oxygen console

10000 Oxygen Demand Indicator

## Military High Altitude Aircraft



High altitude oxygen system component



Oxygen and Pressure Tank

High altitude oxygen system component



Completely Integrated System

Completely Integrated System



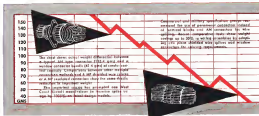
**SCOTT AVIATION CORP.**  
275 BIRCH STREET, LANCASTER, N.Y.

Scott Aviation Corp., 11 North 10th Street, New York 10, New York 10  
Scott Aviation Corp., 275 Birch Street, Lancaster, N.Y. 17601



Conquer the Weight Barrier!

Supersonic Speed Demands Weight Relief...



ask about **AMP** **Active Approach** TO BETTER WORKING

**AMP**

**AMP INCORPORATED**

General Office: 1257 Eastchester Road, Hirschberg, Pa.

Wholly Owned Subsidiaries: AMP-Airbus Products of Canada Inc., Toronto, Canada • AMP-Airbus Products (U.S.A.) Inc., Houston, Texas • AMP-Airbus Products of Mexico, S.A. de C.V., Mexico City, Mexico • AMP-Airbus Products of India, Pvt. Ltd., Bangalore, India • AMP-Airbus Products of Japan, Ltd., Tokyo, Japan



#### RESEARCH

Conducting intensive research in metal design, heat treatment, and high temperature requirements.



#### DEVELOPMENT

Advancing the development of new steel performance capabilities through advanced service tests.



#### PRODUCTION

The steel industry's most advanced facilities for steel production in Watertown, New York.

# 400°F

... for 150 Hours  
continuous duty



## STRATOPWRE®

... HYDRAULIC PUMPS

*Specified for Elevated Temperatures—*

400°F and higher is a reality with advanced STRATOPWRE Abrasive Resistant Bearings, Rings and Manufacturing Steel applied by STRATOPWRE to years of hydraulic experience combine to produce high temperature equipment that meets your demand requirements of tomorrow, today. STRATOPWRE design personnel, working on the most advanced high temperature problems, have produced outstanding results. STRATOPWRE Tubes, incorporating these high temperature developments, are available to prototype quantities.

**WATERTOWN** DIVISION  
THE NEW YORK AIR BRAKE COMPANY  
STARRUCH AVENUE • WATERTOWN • N.Y.

REDUCE YOUR MACHINING COSTS

buy CSI Precision Forgings in

# HIGH TEMPERATURE ALLOYS and TITANIUM

CSI precision forging methods greatly reduce the cost of High Temp Alloy and Titanium parts in two important ways. One—components are so close that machining time is reduced to a bare minimum. Two—CSI methods drastically cut the amount of high speed metals required to produce a batch of forgings.

Canadian Steel Improvement has combined these cost-saving factors with an entirely new forging process for Titanium. Results—CSI offers precision-forged Titanium parts at the lowest price in the world market!



These are some of the characteristics of Titanium forged by the new CSI process:

- Precision tolerances.
- Consistent finishes from surface roughness down to precise micro-finishes.
- Excellent surface finish.
- Dramatic reduction in machining costs—five examples per block will be placed publishing only.
- Consistent quality throughout.

Besides being the best in Titanium, CSI is also highly skilled and experienced in the production of stainless steel and aluminum forgings—and all steel, stainless steel and aluminum forgings and wrought alloys.



## CANADIAN STEEL IMPROVEMENT LIMITED

HORNER AND SECOND AVENUES, TORONTO 14, ONTARIO

Represented in the United States *Only* by— **C. F. RUSSELL COMPANY INC.**

Newington, Connecticut    Bay Shore, New York    Kansas City, Missouri    Los Angeles, California  
Tel. Mchwan 6-4861    Tel. Bay Shore 7-2823    Tel. Biltmore 7092    Tel. Goshute 9-2202



## Why Choose menasco ?

### Because MENASCO QUALITY MEETS ALL STANDARDS

America's first jet transport, the 707 Stratoliner and the Intercontinental will provide new heavy, distance-devouring speed and unimagined smoothness of takeoff, flight and landing. Their military counterparts, the KC-135 Tanker, will make possible global operations of another great BOEING aircraft, the B-52 jet bomber. These airplanes represent another outstanding BOEING contribution to aviation.

In selecting MENASCO to build the nose landing gear for its 707 series transports and its KC-135 Tanker, BOEING was assured that this vital component would meet the exacting requirements of either the Air Force or the Civil Aeronautics Administration. MENASCO'S quality is "built-in" and meets any and all standards.

MENASCO precision fabrication of this BOEING design insures the most effective application of both steel and aluminum for lighter weight and compactness, and the exclusive laminating process insures greater strength and reliability.



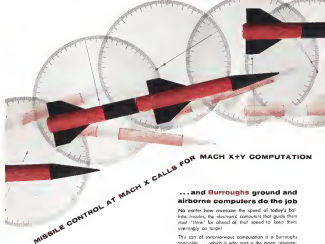
First in development, quality, delivery and service



**menasco manufacturing company**

805 San Fernando Boulevard, Burbank, California

SPECIALISTS IN AIRCRAFT LANDING GEAR



MISSILE CONTROL AT MACH X CALLS FOR MACH X+Y COMPUTATION

### ... and Burroughs ground and airborne computers do the job

No matter how excessive the speed of today's ballistic missiles, the electronic computers that guide them must "think" far ahead of that speed to lead them unerringly on target.

This sort of instantaneous computation is a Burroughs specialty — which is why ours is the major responsibility for the research and development of a guidance phase of the U.S. Air Force Ballistic Missile program in progress embracing ARAS, TITAN and THOR.

We have the proved resources and capabilities for further research and development of even more advanced ground and airborne computers. And our reliability—Burroughs has unendingly delivered on every defense contract undertaken. Not only in electronic computers but in control systems, instrumentation, communications, data processing and others.

In all areas of our proved responsibility and competence, in fact, Burroughs stands ready to see defense contracts through every step, from research to installation and maintenance. Write, call or wire Burroughs Corporation, Defense Contracts Organization, Detroit 30, Mich., or Burroughs Defense District Offices: Fort, Pa.—3086 Linden Ave., Dayton, Ohio—17071 Ventura Blvd., Encino, Cal.—17227 N. St. N.W., Washington, D.C.



THE FOREMOST NAME IN COMPUTATION



## RAM AIR SCOOPS...

that provide pilot with fresh air in emergencies—quickly, easily!

The Whittaker ram scoop offers third themselves struggling to get through an oxygen-depleted atmosphere the result of cockpit smoke, fumes and oil mist which the regular air conditioning systems cannot handle adequately.

New Whittaker's unique Ram Air Scoop provides a complete change of clean, fresh air in a split second—usually a secondary cockpit system that was unusable without fail in an emergency!

The ram air passes through two spring loaded check valves which are provided to prevent reverse flow through unit when scoop is closed.

This simple and extremely light unit—now in use by Lockheed and North American—is contained in the fuselage and is opened and closed in any of six settings by a lever. When the pilot opens the scoop, integral air-to-air valve are actuated by the handle movement.

There is nothing to be worried if the cabin pressure falls and an oxygenating system, the cabin pressurization dump valve, or other units all the pressurization and ventilation systems.

**DIMENSIONS:** Scoop opens 27" wide 2' long. Interior plate 2' x 7", settings from 12" to 30".



SEND THIS COUPON FOR COMPLETE INFORMATION

WM. B. WHITTAKER CO., LTD. DEPT. 234  
912 N. CITRUS AVE. LOS ANGELES 26, CALIF.  
Send please 10¢ and the better information on Whittaker  
Whittaker Ram Air Scoop Valve, P. 762819

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

**Whittaker**

Wm. B. Whittaker Co., Inc., 912 N. Citrus Ave.,  
Los Angeles 26, Calif.  
Newport, Long Island  
Hollywood, California  
Whittaker  
Seattle

May 13, 1957

**AVIATION WEEK**

Vol. 64, No. 19

New York 26-232 W. 42nd St., Phone EDgwood 4-2800 (Night 10-4-3033)  
Washington 4, D.C.—National Press Bldg., Phone MAntwood 4-3414, BUckle 7-4420  
Los Angeles 12-1125 West 6th St., Phone WAshing 4-9351  
Dallas 1-0712 Commerce St., Phone EVerette 7-5117

European Office—1 rue du Temple, Geneva, Switzerland

### Editorial Offices

**PUBLISHER** Robert W. Wells, Jr.  
Robert S. Wells

**MANAGING EDITOR** William W. Jones  
**DEPT. MANAGING EDITOR (TECHNICAL)**  
Gerald A. Anderson  
**MANAGER** Carl Swenson  
**TOP COPY** Milton Saper,  
Edward J. Washfield

**DESIGNER** Irving Davis, Richard Swenson  
**EDITOR** Doug York  
**INDEXER** Robert A. Sullivan  
**RESEARCH** Russell Brown, J. S. Bell, R. W. Johnson  
**EDITORIAL ASSISTANT** Philip J. Rice  
**SECRETARY** Katherine Johnson  
**MAIL ROOM** Charles O. Miller, Carol Clark  
**TRANSPORT** Steve Gorman, J. L. Pate

**CONTRACTOR** Fred Gorman  
**RESEARCH ASSISTANT** Fred A. Sullivan  
**ART DIRECTOR** Lawrence J. Bell  
**ART COPY EDITOR** Robert D. Young  
**PHOTOGRAPHY** Clarence B. Kelly  
**EDITORIAL ASSISTANT** Elizabeth M. Day,  
Barbara Ann, Arlene Hahn, Gloria Harkness  
**RESEARCH** James Harkness

### REGULAR CONTRIBUTORS

**EDITOR** John Wilkins  
**EDITOR** William F. Dugdale  
**EDITOR** Robert S. Penfold  
**EDITOR** North Atlantic  
**EDITOR** John S. Brown  
**EDITOR** Peter Weaver  
**EDITOR** John S. Brown

### INDUSTRIAL AND BUSINESS

**ALASKA** J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown  
**CONNECTICUT** J. S. Brown, H. Day,  
Henry H. Day, J. S. Brown  
**NEW YORK** J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

### MAIL

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

**ADVERTISING AND BUSINESS MANAGER**  
J. S. Brown, Henry H. Day,  
Charles H. Day, J. S. Brown

### Helicopter Group Outlined on VTOL

P. O. Courland Parfitt tells Helicopter Society to improve helicopter before moving to new field.

### Airlines Report More Traffic, Less Profit

Mounting expense threatens to outstrip revenues, airline profits may shrink by as much as 50%.

### T-2J Designated as Primary-Through-Advanced Trainer

Use of proven engine, available components marks North American airplane.

<b>AVIATION ENGINEERING</b>	<b>AIR TRANSPORT</b>
Leaflet Helicopter Program ..... 33	Control Before Control Order ..... 39
Aviation Helicopter Program ..... 34	Control Before Control Order ..... 41
Aviation Helicopter Program ..... 35	Control Before Control Order ..... 42
Aviation Helicopter Program ..... 36	Control Before Control Order ..... 43
Aviation Helicopter Program ..... 37	Control Before Control Order ..... 44
Aviation Helicopter Program ..... 38	Control Before Control Order ..... 45
Aviation Helicopter Program ..... 39	Control Before Control Order ..... 46
Aviation Helicopter Program ..... 40	Control Before Control Order ..... 47
Aviation Helicopter Program ..... 41	Control Before Control Order ..... 48
Aviation Helicopter Program ..... 42	Control Before Control Order ..... 49
Aviation Helicopter Program ..... 43	Control Before Control Order ..... 50
Aviation Helicopter Program ..... 44	Control Before Control Order ..... 51
Aviation Helicopter Program ..... 45	Control Before Control Order ..... 52
Aviation Helicopter Program ..... 46	Control Before Control Order ..... 53
Aviation Helicopter Program ..... 47	Control Before Control Order ..... 54
Aviation Helicopter Program ..... 48	Control Before Control Order ..... 55
Aviation Helicopter Program ..... 49	Control Before Control Order ..... 56
Aviation Helicopter Program ..... 50	Control Before Control Order ..... 57
Aviation Helicopter Program ..... 51	Control Before Control Order ..... 58
Aviation Helicopter Program ..... 52	Control Before Control Order ..... 59
Aviation Helicopter Program ..... 53	Control Before Control Order ..... 60
Aviation Helicopter Program ..... 54	Control Before Control Order ..... 61
Aviation Helicopter Program ..... 55	Control Before Control Order ..... 62
Aviation Helicopter Program ..... 56	Control Before Control Order ..... 63
Aviation Helicopter Program ..... 57	Control Before Control Order ..... 64
Aviation Helicopter Program ..... 58	Control Before Control Order ..... 65
Aviation Helicopter Program ..... 59	Control Before Control Order ..... 66
Aviation Helicopter Program ..... 60	Control Before Control Order ..... 67
Aviation Helicopter Program ..... 61	Control Before Control Order ..... 68
Aviation Helicopter Program ..... 62	Control Before Control Order ..... 69
Aviation Helicopter Program ..... 63	Control Before Control Order ..... 70
Aviation Helicopter Program ..... 64	Control Before Control Order ..... 71
Aviation Helicopter Program ..... 65	Control Before Control Order ..... 72
Aviation Helicopter Program ..... 66	Control Before Control Order ..... 73
Aviation Helicopter Program ..... 67	Control Before Control Order ..... 74
Aviation Helicopter Program ..... 68	Control Before Control Order ..... 75
Aviation Helicopter Program ..... 69	Control Before Control Order ..... 76
Aviation Helicopter Program ..... 70	Control Before Control Order ..... 77
Aviation Helicopter Program ..... 71	Control Before Control Order ..... 78
Aviation Helicopter Program ..... 72	Control Before Control Order ..... 79
Aviation Helicopter Program ..... 73	Control Before Control Order ..... 80
Aviation Helicopter Program ..... 74	Control Before Control Order ..... 81
Aviation Helicopter Program ..... 75	Control Before Control Order ..... 82
Aviation Helicopter Program ..... 76	Control Before Control Order ..... 83
Aviation Helicopter Program ..... 77	Control Before Control Order ..... 84
Aviation Helicopter Program ..... 78	Control Before Control Order ..... 85
Aviation Helicopter Program ..... 79	Control Before Control Order ..... 86
Aviation Helicopter Program ..... 80	Control Before Control Order ..... 87
Aviation Helicopter Program ..... 81	Control Before Control Order ..... 88
Aviation Helicopter Program ..... 82	Control Before Control Order ..... 89
Aviation Helicopter Program ..... 83	Control Before Control Order ..... 90
Aviation Helicopter Program ..... 84	Control Before Control Order ..... 91
Aviation Helicopter Program ..... 85	Control Before Control Order ..... 92
Aviation Helicopter Program ..... 86	Control Before Control Order ..... 93
Aviation Helicopter Program ..... 87	Control Before Control Order ..... 94
Aviation Helicopter Program ..... 88	Control Before Control Order ..... 95
Aviation Helicopter Program ..... 89	Control Before Control Order ..... 96
Aviation Helicopter Program ..... 90	Control Before Control Order ..... 97
Aviation Helicopter Program ..... 91	Control Before Control Order ..... 98
Aviation Helicopter Program ..... 92	Control Before Control Order ..... 99
Aviation Helicopter Program ..... 93	Control Before Control Order ..... 100

### AVIONICS

Infrared Scan as Callous Alarm Hope ..... 45  
Solid State Address Detailed ..... 50  
Filter Center ..... 105

### MANAGEMENT

Management Policies Criticized ..... 28  
Baker Research Subject Name ..... 32  
New Law Could Give Aircraft Warning ..... 53  
Wife's Where ..... 33  
Industry Observer ..... 35  
Washington Workshop ..... 39

### PRODUCTION

Investment Plans Overlooked ..... 71  
Shuttle's Design ..... 76  
Top Milling to Cut Lead Time ..... 85

### SAFETY

Visual Failure in Cessna Crash ..... 713  
Catcher ..... 5  
Getters ..... 142

### EDITORIAL

Aviation News Roundup ..... 31

**COVER:** Army's versatile-to-terrain vehicle, known as the White Sands Vehicle General, is shown in use in a production at the Materiel Co.'s Orlando, Fla., plant. Designed for battlefield use as field artillery, it can be used as a light transport, single tracked loader. It can travel off the dirt in tracks at 12 1/2 mph. Inset: Army is testing Materiel Corp. loader.

Picture Credits:  
16, 65, 71—Wide World; 62—Ernst J. Buffon.

45, 67 copies of this issue printed  
AVIATION WEEK • MAY 13, 1957 • Vol. 64, No. 19

Member AEA and AIAA

# FENWAL UNITS WATCH POTENTIAL HOTSPOTS

## Quick, Accurate Units Advance Aircraft Safety

ASHLAND, MASS — Over-heat protection and temperature control in aircraft has been given a big boost by Fenwal engineers here. They've produced a broad line of extremely accurate and reliable temperature detectors and controls for aircraft.

Based on the unique thermopneumatic principle, the units provide reliable operation and easy repairability. This principle is differentiated equipment wherein the activating control element is a single metal shell. The single metal shell expands or contracts with temperature changes, making or breaking the normally closed electrical circuit.

Vibration, shock and altitude stresses have no adverse effect on the Fenwal units.

The line includes heater controls, cooling effect detectors, differential thermostats, burner compartment over-heat detectors and radiant heat sensitive controls for light-pipe installations.

All are extremely light and compact.

For details on any or all, write to Fenwal Incorporated, Aviation Products Division, 136 Phoenix St., Ashland, Massachusetts.



CONTROLS TEMPERATURE  
... PRECISELY

Here are just a few examples of how Fenwal has solved the problems of over-heat protection and temperature control — and there are several thousand other configurations of these units that can be adapted to almost any aircraft spot protection problem.



## Airlines Face Financial Squeeze

The air transport industry is facing one of its most serious financial crises at a time when it is preparing to offer one of its most appealing opportunities as a service to the traveling public. The gathering financial storm is causing serious apprehensions as the very time that most airlines are well into a program to provide jet-powered service that will offer major gains in speed and comfort to the traveling public.

Airline business volume is continuing to grow at a healthy rate. Flying is continuing to attract a larger portion of the total travel market. The problem is that the gain in business volume is being rapidly eroded by rising costs, and the margin of profit is shrinking to a dangerously low level. The details of this serious air-line cost spiral against total revenues are detailed by Aviation Week's transport editor K. E. Dety on page 36.

### High Costs, Tight Money

There are three principle areas in which costs are rising where airline management has little control over revenues. The major area involves new equipment. The airlines have already needed about \$2.6 billion in new jet turbine powered equipment. This investment is vitally necessary to airline survival in a highly competitive business and will result in economies divided as proposed passenger service. But without a solid financing position, the airlines cannot hope to swing the financing necessary to pay for the new equipment. The current tight money market is making reasonable financing harder to come by and financiers are taking an increasingly dim view of investing in an industry whose future earnings are uncertain.

The action by Capital Airlines is deferring a substantial portion of its new jet equipment purchases until a better financial foundation is laid under its operations (see p. 29) is typical of the equipment financing problems facing the airlines. No airline can finance this new equipment out of savings, and an airline can afford not to enter the jet equipment race if it hopes to survive for the next decade.

Other non-controllable costs increase more from the boost in gas and oil prices and increases in local taxes on these commodities, and the drive of organized labor to push wages upward. These are areas over which airline management can exercise little control in the face of national trends.

### Dangerous Economics

There are other areas that offer some fertile ground for management cost control, but in the airline business the too can be dangerous if reductions encroach into the areas of passenger service and flight safety. It is obvious that economies affecting passenger service and flight safety will accomplish nothing but further deterioration of the airline position.

We have heard a number of solutions to the profit squeeze problem proposed by airline managers, some of them sound and some of them unadvisedly unwise thinking.

The first area is likely to be with us for some time

is a major problem. It may be that a basic fare increase is one of the necessary ingredients in a healthy airline financial picture. But we think the usual solution of the fare problem that often causes reaction to the traveling public as well as the airline must come from a general revision of the current farework, the structure based on the modern economic facts of the air transport industry and not just from adding another lumpy patch to an already complicated and confusing tariff system.

### Revised Tariffs For Jet Age

Currently, the jet era of air transport will need a basically revised tariff system to cope with the new problem facing both operators and customers as a result of the technical revolution.

Some operators are inclined to blame their current problems on the lack of new competition on their favorite routes authorized by the Civil Aeronautics Board during the past several years. New competition is reducing volume in people who have been staying a financial harvest from a private airline patch. But there is no question that the added element of competition introduced by the CAB has notably improved passenger service and added to public convenience in some areas where these elements were badly needed.

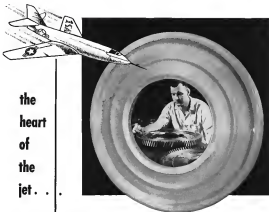
We think that increased competition, while it may temporarily upset some long-standing economies, is a healthy element and will in the long run improve public service and airline traffic for those airlines that are willing to handle and expand their market. The continued growth of the total air travel market before the idea catalyzed by some airline managements that the air traffic volume is a fixed total to be divided among members of an established cartel.

### Traffic Control DRAIN

We also predict a lack of top level airline management interest in one of the most serious factors now threatening the healthy growth of air traffic volume. This is the traffic control bottleneck that automatically absorbs millions of dollars out of every airline treasury annually. There are some people now in government such as James T. Pyle, Civil Aeronautics Administrator, and Edward P. Catts, special presidential assistant handling planning matters, who are pushing hard to achieve progress on this front, and the Air Transport Association staff headed by Milton Arnold has long been in the vanguard of the battle. There are many, many things that can be done now to widen the air traffic control bottleneck and stop the unnecessary drain of airline dollars in bad weather. But they cannot be done without the vigorous and continued support of the highest elements of airline management.

Airline managements are going to see every penny of their dollars during the next five years working with fuel and other facts of the financial problems facing the air transport industry. Never in the history of this industry have the rewards for successful management been so high nor the penalty for failure so drastic.

—Robert Hlatk



the  
heart  
of  
the  
jet . . .

## —DEPENDABLE FORGINGS—

Ever since the beginning of the development of mechanical power, the heart of power producing machinery has been forgings.

The latest development in the field of mechanical power is the aircraft turbo-jet engine. Here again, the important highly stressed components — the turbine wheels and the compressor discs — are forgings and here also more of these forgings are produced by

Wyman-Gordon than by any other company.

Entirely new problems, mechanical and metallurgical, are involved in the production of these vital parts — problems which require the maximum in experience, know-how and research facilities. Wyman-Gordon excels in all of these areas and continues today as for nearly 75 years in the forefront of new forging developments.

Seen through the porthole of this compressor disc is the finished forging — an example of the ultimate in quality and precision.

## WYMAN-GORDON COMPANY

Established 1882

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM  
WORCESTER 1, MASSACHUSETTS  
HARVEY, ILLINOIS • DETROIT, MICHIGAN

## WHO'S WHERE

### In the Front Office

Thomas S. Nichols, bond chairman, Old-Morison General Corp., New York, N. Y. Mr. Nichols succeeds John M. Old as chairman financial and operating policy committee. Stanley de J. Osborne succeeds Mr. Nichols as president.

Henry W. Johnson, bond chairman, Kansas Co., New York. Also Irving B. Selye, executive vice president; and David S. Miller, vice president marketing.

Carl Frank C. Wolfe, director, Parker Appliances Co., Cleveland, Ohio.

Edgar F. Kamm, Dr. Arnold O. Redman and William G. Reed, directors, Standard Research Institute, Menlo Park, Calif.

Miss Robert A. J. English (JUN), as I, president and a director, Midland Inc., Houston, Calif.

David E. Shonoff, president and Harold D. Hochman, vice president, Eni Ship Service, Inc., San Francisco, Calif.

Joseph A. Pralenti, president, and Richard J. Holt, vice president, Industrial Products Division, International Telephone and Telegraph Corp., Canton, N. J.

Robert F. Lane, vice president, aviation products, and Alfred Weiss, engineering liaison, integrated power supply operations. Robert F. Lane, executive vice president, Farley & Porter Co., Hoboken, N. J.

Dean M. Meylan, vice president and a director, Newkirk Industries Co., Cleveland, Ohio.

Edward E. Shover, vice president, Bell-McIntosh Institute, Columbia, Ohio.

W. J. Chapp, vice president and, lease manager, Lockheed Aircraft Service-International, Inc., New York. International Air Corp., N. Y.

William G. Gurd, a vice president, Bell Aircraft Corp., Buffalo, N. Y.

Robert Kim Yates, vice president—engineering and manufacturing, Gross Hydrolic, Inc., Jersey, N. Y.

Merlin Shadash, a vice president, United Aircraft Products, Inc., Dayton, Ohio.

E. W. McKean, general manager, Telling Soil Cap, Inc., San Gabriel, Calif.

### Honors and Elections

Col John Paul Stapp has been selected the first recipient of the Langley Award for outstanding research into the broader aspects of astronautics and earth-atmosphere flight. The Award, established last year by Hans Labertowski, will be presented at the annual meeting of the Aero Medical Association in Denver.

Capt. Milton Leigh McCarty and Capt. Curtis T. Stang, Jr., USAF, have received the American Legion Aviation Post Valor Award. The Aviation Valor Medal is presented annually to a member of USAF who has distinguished himself by a conspicuous act of valor as recognized and awarded in aerial flight to his unit or command.

Dr. Franklin F. Eckhart, USN pilot, has been awarded the 1957 Flight Test Engineering Fellowship by the Institute of the Aeronautical Sciences. The Fellowship, gift of an anonymous donor, covers two years of study.

## INDUSTRY OBSERVER

Boeing's improved version of the B-52 is scheduled to fly soon and will phase into the production program in larger numbers than originally planned because of the availability of earlier B-52 model production to a 15 per cent rate. More advantage of the new B-52 is substantially increased range due to a larger wing containing increased fuel tanks and the substitution of the Pratt & Whitney JT5 for the JT3 engine. Approximately 20% of the current total now has been eliminated with no anticipated cost or stability penalty.

Inward-guided Sidehunter air-to-air missile developed by Naval Ordnance Test Station, China Lake, Calif., has an effective range of approximately 1,500 yards at sea level. Control lines are in form of coated cables just behind the nose influence four miles out of visible condition in which missile is lethal within 15 ft. Control cables are stabilized by small bar-type wheel turning at very high speed.

Convair F-106 six-engine interceptor powered by a Pratt & Whitney JT5 with thrustvector has reached a maximum speed of Mach 1.87 at Edwards AFB, Calif.

France is developing a fit on the tail structure of its G.100 lightweight fighter entry in the NATO competition to solve the better problem that caused structural failure in flight during the prototype test program. The failure was corrected technical assistance from French researchers, who analyzed the structural characteristics of the G.91 copageage system, and the National Advisory Committee for Aeronautics which developed the fit in its Langley Laboratory wind tunnels.

USAF is now moving back toward the two-man fighter for its all-weather interceptor system. Many reasons are increased inherent risk range that can be obtained from a skilled operator supervising the pilot's work and because of the availability of complete automatic equipment on which the mission interceptive is dependent to complete its mission. Advantages of carrying a radar operator now appear to be only enough the discharges in terms of successful mission completion.

Navy this year will begin conversion of obsolescent Grumman F9F-6s to serve as jet trainers for air-to-air and surface-to-air missile target practice.

Air Force has specified F4U-140 turboprop for wingtip installations on about 18 Convair T-28C trainers to be assigned to the Air Force Academy at Colorado Springs. This would provide improved instrument and climb performance in the altitude of the field they train on. Addition of two T-14s will add an installed weight of 525 lb. and provide an extra 3,000 lb. thrust in application for two Pratt & Whitney R7800 turbo engine Convair plus to offset the J41 engine installation to allow operation of the Convair Lancer since it would provide a faster climb speed than the Viscount turboprop airframe. This will cost approximately \$29,000 each.

Navy's aircraft production program is 91% on schedule with at least part of the slippage due to design and installation changes. Contracts behind their production schedules as of March 31 include Douglas A1D, A4D-1 and F4D; Lockheed's T2V jet trainer, Pratt & Whitney J57-P-6W jet engine, and Lockheed and control units for Convair's F-106C turbo-boost engine.

Messier has developed a tactical airfield fuel dispensing system that can be stored under its helicopter. Systems include individual systems tank systems, a small emergency system and a pipeline hose system connected to supply ducts as follows.

Cornell Aeronautical Laboratory is modifying a Weather Service CW radar set as a standby warning device. Turbulence are changed with electrical sensors, and it is believed that as turbine is advanced gun will electrical radar set to identify and trace hostile activity.



## HOW THE SILICONES MAN HELPED... LIGHT UP THE LIFE OF A DOUBLE-DECKED COMMUTER

Greater comfort for commuters... and increased efficiency for railroads in these double decked coaches now in service on the Chicago and North Branch Railroad. Brighter, cooler, air conditioned... and passenger capacity more than doubled. Problem? Greatly increased power demand had no more space for motor generating equipment. Solution? Class II insulation with Silicones.

The engineering staff of Washburn Motor Company and Electroblek Corporation, cooperating with the C&N, designed and built a Class II generator using UNION CARBIDE Silicones as the insulating agent. Silicones stand up under temperatures and loads that break down other insulating materials. The result is a rest no larger than those

previously used, but supplying sufficient power to meet the new demands plus any overhead conditions.

This is another example of how the UNION CARBIDE Silicones Man has helped solve an "impossible" insulation problem. Silicones permit smaller units for equal jobs... or greater capacity for added loads. To obtain more information, write for "Class II Insulation with UNION CARBIDE Silicones." Address: Dept. AW-52, Silicones Division, Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.



The new "Union Carbide" is a trademark of UCC. A Carbid-Electro Company Division of Union Carbide Electric Limited, Industrial Division.

## Washington Roundup

### Gen. Power New SAC Chief

LT. Gen. Thomas S. Power will take over command of the Strategic Air Command, replacing Gen. Curtis LeMay who has been promoted to USAF vice chief of staff. Gen. Power served under Gen. LeMay as vice commander of SAC from 1949 until appointment to his present post as commander of the Air Research and Development Command in April, 1954.

In another shift of major USAF personnel which began with the selection of Gen. Nathan P. Twining as chairman of the Joint Chiefs of Staff (AW March 13, p. 75), Lt. Gen. Frank Everest will move from his present post as deputy chief of staff for operations to replace Lt. Gen. William Tunner as commander of the U. S. Air Force in Europe. Gen. Tunner, in turn, is expected to succeed Gen. Joseph Smith as head of the Military Air Transport Service (AW April 13, p. 23).

### Fast Hearing For Curtis

The extent of congressional interest in air traffic control is indicated by the fact that hearings on proposals by Edward F. Curtis, special Presidential assistant, for the establishment of an Airways Modernization Board (AW April 6, p. 23) will be held before the full Senate Commerce Committee headed by Sen. Warren Magnuson (D-Wash.). Hearings are scheduled to begin May 14. Airline executives are generally fast considered by the aviation subcommittee.

The Board to "develop, modify, test and evaluate rules, procedures, facilities and devices" for air navigation and traffic control would be composed of the Secretary of Commerce, the Secretary of Defense, and a Presidential appointee not affiliated with any government agency. A second report by Curtis, recommending reorganization of the functions of Civil Aeronautics Administration and Civil Aeronautics Board, is expected to be submitted to Congress shortly.

### For Everest: Belated Bow

USAF has received permission to display the Bessie and Bessie in front of the new Air Force Day, but the Defense Department has turned down a proposal to display the X-70 research plane as indicated despite the fact that it has been discredited by the Air Force. Navajo chief is an adviser on the continuing effort to tell the public about aircraft program. Defense Department has told USAF it has no objection to Lt. Col. Fred K. "Pat" Everest once confirms that he flew in events of 1905 only in 1955 in the Bell X-2. Almost a year ago, Everest went the Air Force. Now flight test would be his information, but until now he was allowed to admit that he did it (AW Aug. 6, 1956, p. 154). Since he received the X-2 was flown more than 2,300 mph by Capt. Richard G. Age, who was killed in the research service (AW Nov. 5, 1955, p. 18).

### Newbury Replacement Sought

Defense Department is still searching for a successor to Frank D. Newbury as Assistant Secretary of Defense for Research and Engineering. Defense Research Charles E. Wilson was the first choice, but it is very important whether his new role is a research one or captain, but he is consulting with Deputy Secretary of Defense Douglas

and A. Quaker. Marshall, William M. Holden, deputy to Newbury, has been named Special Assistant to the Secretary of Defense for Guided Missiles, replacing Ego V. Maguire. Maguire will continue as a part-time consultant.

### White House Decision

Look for White House decision in near future on two separate air route cases involving Pan American World Airways and Northwest Airlines. In one case, Northwest is seeking a permanent certificate on its Coast Circle route, which is opposed by Pan American. In the other, Pan American seeks authority to fly the Coast Circle route, a proposal Northwest opposes.

Both cases are that the CAB has recommended permanent certificates for Northwest and one of the Coast Circle routes from Galveston to Tokyo by Pan American. Northwest operates to Tokyo via Portland and Seattle.

### Willis Alaska Head?

Leading contractor for the production of Alaska Airlines is named Nelson David as Charles F. Willis, former assistant to President Eisenhower and now a vice president of W. R. Grace & Co. Reorganization of David, who had been president and general manager for Alaska Airlines since 1952, becomes effective on Wednesday.

### Half-Measure For Poy Plan

Defense Department's own compromise with the Civilian Conservation Commission provides military pay raise of \$12 to \$19 a month for 366,000 military men with special skills. Cost will be about \$93 million the first year, and it will not permit pay to meet most requests of the committee's report suggestions (AW May 6, p. 25).

Charles Ralph J. Conkatz, president of the General Electric Co., says Monday's report cannot be achieved by half measures. He already has told Defense Secretary Charles E. Wilson that the committee proposals, if adopted, can improve combat capability, 15%, save up to \$5 billion a year before 1962, cut training accidents and improve the general defense equipment situation.

While Conkatz and the committee were consulted with Wilson in the Pentagon last week, reports were leaked out of the room as Wilson suggested they might like to ask questions about the program. The business Assistant Defense Secretary Mervyn Snyder, former White House press aide now in charge of Pentagon information services.

### Budget Cuts

Leading Senator on bill in line with the House drive to make deep reductions in the fiscal 1956 budget Sen. Richard Russell (D-Ga.), chairman of the Senate Armed Services Committee, says he hopes for a reduction of about \$1.5 billion in the Administration's \$15 billion proposal. Russell believes the cuts can be largely accomplished by eliminating expenditures in weapon development projects. Last year, Russell supported the Senate's \$9.5 billion reduction in the defense budget over Administration recommendations and \$1.5 billion above the House allowance.



## Helicopter Awards

Washington—Capt. Wayne W. Egert, USAF, experimental test pilot last week, was posthumously awarded the American Helicopter Society's highest honor, the Dr. Alexander Glushko Award.

Capt. Egert, commander of the outstanding helicopter and pilot, was killed in a crash of Edwards AF-1 only this year. In one year of experimental test work, he had flown more than 18 types of helicopters and accumulated about 1,500 hours of rotary-wing time.

The society's Rando Award was presented to Robert Stein, president of Pecos Area Helicopters, Lakeland, Louisiana. Stein was honored for developing the use of rotary wing to offshore oil exploration and drilling operations.

Two AIAA History Fellowships were also awarded. They were given to Jean-René Howard, assistant to the director of the Helicopter Society of the American, Redlands, Calif., and one of the few women helicopter pilots, and R. Paul Johnston, director of the Institute of Aeronautical Sciences. Johnston was chosen for his help in the management and development of the society in its early years. The awards were presented at the 13th Annual National Forum.

news was told by Lt. Col. Dore N. Fribbins, commander of USAF's 22nd Helicopter Squadron.

Col. Fribbins said his squadron has 15 H-21's and operates from 11,500 ft maximum gross weight at 10,000 ft maximum gross weight at 1,500 ft with 1,500 lb of fuel in 10,000 ft. He pointed out that the rugged Arctic climate requires landing gear to have dual wheels of survival gear in addition to an auxiliary power and so on.

USAF has focused in the Dore Lane operation that there is a definite requirement for a two-engine helicopter with higher speed and greater payload. The H-21s do some operations but with out the provision of flotation gear to recover there is a payload penalty of 100 lb when it is carried. The gear could be easily eliminated with two-engine reliability, Col. Fribbins said.

## Doman Sells LZ-5s, Prepares Production

Dunbar, Conn.-based Helicopters is negotiating additional financing to develop production capacity needed for 13 or possibly 14 contract units with Helicopteros de Colombia, Bogota, for 10 LZ-5's. Value of the contract is approximately \$1 million including spares.

Helicopteros is also Doman sales agent for the LZ-5 in Colombia and Venezuela. Under the terms of the contract, Doman is to deliver its first LZ-5 to Helicopteros in four months. To meet this date, the company will probably procure one of its demonstrators.

Doman also hopes to secure current pending negotiations with other prospects, since it estimates that it needs at least double the current order to develop production tooling properly. Helicopteros contract estimates that four sets of production tooling will take approximately nine months.

## Defense Procurement Policies Criticized

Washington—Defense Department's procurement policies and procedures for helicopter procurements were criticized in a report by a study conducted as part of "Defense," despite some improvements over the past year, in a staff project report made to the House Appropriations Committee.

Notable deficiencies pointed out by the report were in the development of cost principles, subcontracting relationships and guidelines and the comparison of prices and parts requirements.

The report is a follow-up to a report made to the committee last year (AW March 25, 1958, p. 18) by George Wilson, O.D., Teri, chairman of the Appropriations Subcommittee on the Armed Services, and a representative of the staff investigation over the coming year already has been submitted.

The study advance that has been made in the establishment of cost principles for contract acquisition, the report said, has been "a wide area of continuing improvement."

The report objected that the three relative source tenders to operate under that differing guide from an subcontracting policy. General Defense Department guidance is needed, the report said.

The report declared that "very little has been accomplished" and "immediate action is necessary" to tighten the government's trade relationship and to increase the role of industry in contract negotiations before final commitments are made.

An error was corrected by contracting to use firm, limit in the reduced by its contract with an option and parts requirements, despite the fact that independent studies by the

Military Contract and the Real Corp. showed that the demand for aircraft parts is "highly sporadic and not directly related to other flying time programs or aircraft operations."

In the Army, the report said, there is a lack of adequate review of prices and parts requirements and that "the process, oriented to its obligate funds before the end of the fiscal year."

Other points included:

- Review by General Accounting Office has had "a very salutary effect" in reducing the loose contract conditions of orders of award.
- Conditions of the GAO reviews was noted.
- There is "discrepancy" between Army and Air Force in policies or results which require correction.

- Significant improvements have been made over the past year in delineating the production area from the research and development area in negotiated contracts—and lowering the use of production funds for research and development work.

That, the staff objected in the 1956 report, enables a contractor with a production contract to obtain an advantage in getting additional production contracts.

- Good progress has been made in stabilizing the high turnover rate of procurement personnel and raising their standards of competence through attrition training programs. The staff previously objected that sudden job turnover personnel was at a disadvantage in dealing with the high-powered procurement personnel of contractors.

## Jet Version of KB-50 Tested by ARDC

Wright-Patterson AFB, Ohio—A new jet version of the KB-50 tanker is undergoing flight tests at the Wright Air Development Center.

Designated the KB-50J, the aircraft was modified by Hayes Aircraft Corp., of Birmingham, Ala., with the addition of two General Electric J47 jet engines mounted on the wings, and two additional engines and the wing tips. Each engine creates 6,000 lb thrust.

In addition to providing use of shorter runways, the added power will speed climb or cruise, reduce the required fuel for fighter escorts so that the mother plane will not have to maintain non-stalling speeds.

## Igor Sikorsky to Retire As Engineering Manager

Igor I. Sikorsky will retire this month from his post of engineering manager of Sikorsky Aircraft Co. in the reduced staff of the company's Chief Aircraft Group. The 68-year-old helicopter pioneer will be retained in the corporation as a consultant.



INCIDENTAL: Vertigo has low over ground clearance after making transition from vertical takeoff to the first turn.

## X-13 Completes Transition Flight

Edwards AFB, Calif.—USAF and Ryan Associates Co. announced last week that the X-13 Vertigo, jet-propelled VTOL aircraft, has completed a transition flight.

The first jet engine from vertical takeoff, to high speed horizontal flight and back to hovering for a vertical landing was made on April 11 by Peter F. Gosse, Ryan's chief engineering test pilot.

### Avon Turbjet

No performance figures were released, and spokesman said they are not important because the X13 is designed to evaluate the concept and controls which, with an engine option speed up the design.

The jet VTOL research plane has

been flying at the USAF flight test center here for more than a year. Powered by a Rolls-Royce Avon turbojet engine, it is not a true jet but a full-size airplane that requires a special ground service trailer for takeoffs and landings.

A single hook, mounted under the forward fuselage holds the X-13 in position and engages to hold it on the landing mechanism when it lands. The hook of the trailer is braked and lifted to the vertical position to launch or recover the plane, and this it is lowered to transport it in a horizontal position.

The Vertigo plane has a jet engine control system to guide it in hovering and slow flight. It is operated by a ducting that jet engine exhaust and aerodynamic thrust.

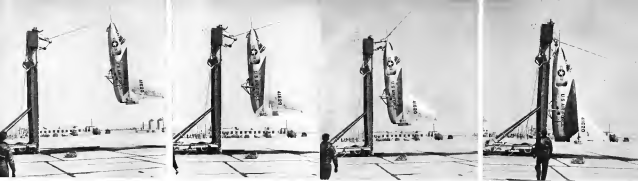
The X-13 also has conventional controls for forward, fast flight operated from a stick and yoke.

Ryan has been working on the project under a USAF contract since 1953. Prior to that, during 1948 to 1947, the company had been doing research on the concept for the Navy's Bureau of Aeronautics.

### Vertigo Advantages

Vertigo's advantages include:

- It can land and takeoff in an open field the size of a tennis court, providing low dispersion capability for land-based fighters.
- At sea, jet VTOL aircraft could be dispersed within a tail, faster, allowing carriers of all defense fighters of necessity.
- Lack of conventional landing gear



TRAILER BED lowers to horizontal position (above) to pilot on and from the Vertigo. Raising and lowering mechanism is hydraulic.

**LANDING.** X-13 stands on its tail as it approaches elevated level of ground service track; and looks on (above, left to right) front portion of the experimental jet VTOL, shows Vertigo's angle hook, and upper structure. The hook engages a cable extended from top of track bed. Stripped beam across its guide to pilot in looking for reaction control system, used to guide the X-13 as cable is lowering and slow flight, is operated by deflecting exhaust and moving throttle. At lower right, X-13 is hooked on its landing and ready for lowering forward to a low-speed position.

tail down on weight and improves the configuration for high-speed performers.

- New mobility for fighter seats can be realized. The jet VTOL will be an independent of movement as a helicopter.
- High thrust-to-weight ratio may result in better combat capabilities than is possible with conventional jet fighters. It will improve climb, acceleration and maneuverability.

The manufacturer reports that the X-13 is easy to fly and will require little additional pilot training.

The aircraft is approximately 24 ft long, 14 ft high and has a wing span of 21 ft. It is a working on another VTOL design for USAF and the Navy.







be substituted for each other with one. Can Fock give us examples of these developments with more than one application?

• One-half of the North American booster engine package developed for Atlas is the propellant unit for Thor. • Booster and sustainer engines being developed by Aerojet for the Titan represent a competing design.

• New ones for the Titan compete with the new ones being developed for Atlas and Thor.

• Guidance systems for Atlas compete with the one for Titan and Thor. Each of both of these developments are competing systems in different types of guidance.

If either of the latter systems, it could replace those now associated with all three systems.

## Aerojet Delivers Vanguard Engine

Second-stage, liquid-fueled propulsion system for the earth satellite launching vehicle of Project Vanguard has been delivered to the Martin Co. and Navy by Aerojet-General, Azusa, Calif.

Second-stage engine is gimbal-mounted and produced in girth and cast by electro-kinematic controls. Inertial reference system in the second-stage provides necessary guidance for three periods of eight-and-a-half-minute flight; second-stage powered flight, and second-stage coasting flight.

After separation from the first stage at altitude of about 35 mi., second-stage will ignite and proceed under power to a height of about 140 mi. It will then

coast forward about 700 mi. in range to the orbital height of 700 mi., at which altitude the third-stage and attached satellite will be fired.

First stage provides most of the energy to raise the satellite to orbital height and about 15% of the required orbital velocity of 25,000 ft/sec. (18,000 mph). Second stage supplies the rest of the energy needed to get the third stage of the satellite to the required altitude and 31% of orbital velocity.

Engine is a near-orthogonal, pressure-fed, liquid-propellant unit using white fuming sulfuric acid and uncrystallized dimethylhydrazine. Tank assembly was fabricated from stainless steel (316), April 18, p. 33.



Vanguard Vehicle Test, Firing

second and vehicle in the Vanguard earth satellite program is completed. First flight of the USAF Missile Test Carrier, Pegasus AFB, FL. Viking rocket (left) made by Martin Co. is used for first test prior to firing. Navy said the vehicle weighed an altitude of 120 mi., and attained a speed of 8,500 mph. Second stage engine for orbital satellite vehicle has been delivered by Aerojet-General Corp. Atlas stages two, at about 16 mi. altitude, it will power Vanguard to an altitude of 140 mi., then coast to 300 mi. orbital height.



Stratos' experience with aircraft air conditioning systems has been applied to a new, lightweight air conditioner designed for use with gas turbine compressors such as the MA-1A and MA-2 types. Meeting Type MB-1 requirements, the unit is Stratos Model GEA-120-1.

Composed of aircraft quality components, the system is packaged as a compact unit measuring only 48" x 50" x 20". The controls—connected to the package solely by an electrical cable—can be remotely located and, where desired, taken directly into the aircraft.

For additional data on Stratos' line of air conditioning systems, write to:

**STRATOS**  
A DIVISION OF NATIONAL INSTRUMENT & SIGNAL CORPORATION

Head Plant, Bay Shore, L. I., N. Y.  
Western Branch: 2150 Sycamore Ave., Redwood City, Calif.



Stratos Model GEA-120-1 air conditioning system being prepared for production test.





A composite picture with profits of the American Division of Kelsey-Hayes.

### precision blades for flight propulsion

Supercity blades, turbos and vane—precision components for jet engines—two products of the American Division of Kelsey-Hayes. Kelsey-Hayes also produces through its own various milling facilities,

the special alloy blades that go into these and other products demanding high tensile strength in the high temperature field. Kelsey-Hayes Company, General Office, Detroit 33, Michigan.

# KELSEY-HAYES

**Airline, Aerospace and Agricultural Parts • Hand Tools for Industry and Home.**  
 10 Plants • 1000+ Sales and Service Branches • McCrometer Products • Lin-A-Matic • Gardner, Wharton, Dennis, Capital Machine, Wilshire • Springfield, Ohio—2 plants—BPPCO America Division office, New York—4 plants—Olson, Depp, Pepp and Ted Divisions • Champion Iron Foundry • Metal Form Engineering and Sheet Services.

## AIR TRANSPORT

# Airlines Report More Traffic, Less Profit

**Mounting expenses threaten to outstrip revenues; airline profits may shrink by as much as 50%.**

By L. L. Doy

Washington—Airline revenues continued to slack during the last three months of 1957, but earnings followed the downward trend set in 1956. Profits may shrink by as much as 50% this year.

Initial reports of domestic business activity during the first quarter indicate the healthy growth picture of the industry has not slackened, and airlines are expected to report a 10 to 12% increase in passenger traffic in 1957.

Mounting expenses, however, are rapidly outstripping revenues, and some officials are predicting substantial losses in 1958 unless some form of relief is provided.

Seven airlines—Eastern, Capital, Delta, Eastern, Northwest, TWA and United—have petitioned the Civil Aeronautics Board for a 6% percentage fare increase as the most logical way of offsetting rising costs.

The profit squeeze first became evident when domestic airline profits dropped from an all-time high of \$63 million in 1955 to \$37.4 million in 1956. Local service airlines reported an estimated \$923,000 loss in 1956 as compared with \$175,000 profit for 1955. At the same time, net profits of the international carriers rose from \$13.2 million in 1955 to \$20.3 million in 1956.

Prospects for a 3 to 12% increase in passenger traffic each year for the next five years appear to be excellent. But this is substantially below the average 16% gain recorded during the past five years as the 275 services experienced from 1946 to 1951.

### Governor Spending Up

According to Commerce Department statistics, consumer spending for airline travel has expanded more steadily during the previous period than any other major product or service category.

Available seat miles appear to be getting an unusual percentage growth, a second major factor raising the profit equation. If deliveries of new equipment held to planned schedule, available seat miles may increase by as much as 12% in 1958 in comparison with a 12% increase in 1956.

Rate of retirement of old equipment in new equipment is never if not been fully established by most airlines,

as it is difficult to measure seat capacity during the next year monthly. But the track is known: during 1956, 124 aircraft were added to airline fleets, and last year increased by 15.6%. A total of 216 new aircraft are scheduled for delivery this year. And at least one airline is retiring aircraft at a rate that is slower than that of old equipment at prices it considers favorable.

### Profit's Squeeze

C. R. Smith, American Airlines president, accurately pointed out that airline profits have been hit adversely by two policies of the CAB.

• **Fares:** to increase fares despite rising costs.

• **Throughput of competition:** to ease a gradual increase in the total service for air mile on the total traffic service.

Smith says the CAB policy of increasing the number of airlines on major routes has "thinned out" the total traffic available to any of them. He adds that, in many cases, this situation has reduced load factors and contributed to operating losses on marginal routes.

Other observers feel the increase in competition may result in a steady increase out of proportion to normal traffic growth. One estimate places the traffic growth necessary to retain load factors above the break-even point at 15% during 1957 in comparison with the predicted 12%.

Competition has been added to 10 of the 25 leading airline travel markets during the past three years, and CAB authority has been granted to add total airlines on 14 of the 25 more route segments. Biggest increase has been on the New York-Washington route where nine airlines now operate as compared with three in 1955.

### End of Trunk Subsidy?

It is not evident, however, that the CAB policy of broadening competition has strengthened the so-called "spinal" carriers to a point that may bring the end of all elements of trunkline subsidy this year for the first time in CAB history.

Continental Airlines recently refused to be removed from subsidy with the inauguration of service over its recently won Los Angeles-Chicago route on April 25. CAB subsequently issued a show-cause order as a first step toward dropping Continental's subsidy.

Northeast also has been ordered by the CAB to show cause why it should not be removed from subsidy, but the airline has protested at least further extension of its service over its new New York-Florida route before it even starts self-sufficiency.

Worried reports to have it all fact of 33 DC-8s as operation in September and to begin service with the first of five B-70s (airplane) transports late this year. When the airline operations are self-sufficient, so U. S. airlines will be government independent.

Most airlines agree that the 25

## Capital Defers Comet Order

Washington—Capital Airlines has temporarily shelved its plan to take delivery on an additional 21 Viking Viscount turboprop and 14 jet & Lockheed Constellation because of a slight increase in the airline's net loss for the first quarter of 1957.

Capital has notified a group of 24 banks headed by New York City's Manhattan Trust that it will not use the credit lines but prefer to cover the purchase of the new equipment, at least not for the present. De Hoffland and Viking Aerospace also has been told of the delay.

Capital's net loss for the period checked from \$1 million in the first quarter of 1956 to \$1.9 million for the 1957 period. Operating losses, however, jumped from \$11.5 million to \$20.9 million.

A Capital official said the airline is deferring the purchase because it does not want to increase its liabilities while losses are being covered. He added that high interest costs at 1955.19 and heavy depreciation charges of \$2,134,141 on the Viscounts it already owns have contributed to the net loss.

However, he predicted a profit for the year and said the order for the new aircraft probably will be made late in "the second quarter." He said the airline will report a profit for the month of April as compared with a loss in the same month last year.

increase in fees is not essential to cover profit margins but they concede that it is not a complete solution. The notion of decreasing a low rate of air-mile-based open engine cost line book depreciation—the low under fee for holding down savings (AW March 23, p. 44).

According to Stuart Taylor, Air Transport Line president, engine air-line fees have shown an increase of slightly less than 3% since 1976. But fees have increased 27%, not less as he suggested last June (ENR).

The CAB requested the airlines' proposed for a 6% increase in March, and hearings on the case are scheduled to be commenced tomorrow. The increase is effective for 1980 due to March 2. The airlines will file the General Aviation Fuel Interchange referred by the CAB presently as a result of strong congressional pressure for an early replacement of motor fuels (ENR December 15, p. 10). The Enbridge Collier (D-N.Y.) struggled last last year for a general rate reduction and virtually forced the first re-vegetation upon the CAB.

#### Capital Traffic Gains 55%

During the last three months of the year, Capital found the most specific traffic gain with a 57% increase over the same period last year. The air-mile statistics for the increase in the sailing power of its fleet of 39 Viscounts.

American Airlines reported a gross revenue increase for the quarter from \$64 million to \$72 million, a 12% increase of \$8 million. Expenses jumped from \$60.2 million to \$59.6 million. Profits dropped from \$3.8 million to \$2.4 million. Lines World Airlines reported a first quarter net operating loss of \$7,352,000, which, after tax credits of \$2.9 million and net operating losses outside of \$1,167,000 resulted in a net loss of \$5,185,000. The 1976 first quarter net loss was \$2.6 million.

Operating increases of the airline followed the general pattern of income with a check on revenues from \$49.5 million in 1975 to \$55.6 million in 1977. Both TWA and Capital had included an operating reduction program in attempts to regain their profit margin.

Higher rates and the continuing rise in prices are making a strong impact on operating expenses. Several operators will be faced with renegotiation of open contracts that were likely made to lead to higher rates.

United Airlines reported an 11% increase in operating expense during the last three months compared to the same period last year.

The airline's operating net income increased 9% during the period, but lost before depreciation from \$1,075 to \$1.19

million. United saw up from \$57 million to \$68.2 million.

In announcing United's first quarter loss of \$1.5 million as compared with a \$67,000 profit last year, President W. A. Patterson said the "return loss increase is well justified by higher costs and the need for adequate energy during the period of preparation for the air age."

#### Money Tight

To date, U.S. carriers are committed to produce 1977 deliveries and subsequent shipments of a total of 57.6 billion. With the tight money situation, airlines that have not already completed financial arrangements may have difficulty in raising capital to meet these commitments, particularly if the rising price is ineffective to encourage a total order of 5103 airplanes, against which advance payments of \$7,911,000 have been made to date.

Delta, which reports on a June fiscal year basis, closed its 1976 operating revenues from \$16 billion in the same period ending March 31, 1976 to \$17 billion for the same period of 1977.

Expenses climbed from \$42.6 million to \$5.4 million and the net income plummeted from \$16 to \$1.5 million.

Northwest Airlines reported an increase in expense to \$12.5 million for the first quarter of 1977 as compared with \$13.3 million during the same period of 1976. Revenue was up from \$16.2 million to \$16.6 million.

The airline's 1976 operating period was slightly from \$13,500 to \$14,700.

Continental's first quarter expense rose from \$12.4 million to \$13.5 million. Net profit for the period was \$104,000 in 1976 to \$271,000 in 1977. Passenger revenues climbed 11.9%, but expenses were held to a 9% increase.

Sabena in the airline during the three-month period delivered from \$140,000 to \$151,000.

Western Airlines covering its 145 million program expense program through the air of since and looking to an order to the Presidential Inauguration Co. at the amount of \$12 million at 4% last year, the airline publicly offered \$1 million in 1977. The airline was used as it is in 1977. The airline was used as it is in 1977. The airline was used as it is in 1977.

Study of Caravelle operations over the Vinyr route indicated it would cover at 190 tons with a payload of 12,800 lb and its operating cost per seat mile of 1.3 cents.

At France has ordered 13 Caravelles with first delivery scheduled for the end of 1978 and has an option for 12 under Italian Equinox service with the Caravelle scheduled for 1979 over

Caravelle such as Eastern, United and American have satisfactorily completed equipment assignments in anticipation of equipment purchases. For example, Eastern's requirements for the purchase of six units, including one of seven units totaling \$15 million are covered by \$120 million 4% sinking fund debenture added to Management Life Insurance, Prudential Insurance and Mutual Life Insurance Co. at New York. Bank loans of up to \$16 million are available until December, 1976.

These funds will be supplemented by current capital, including deposits from CMAA, Los Angeles, which has delivered on the list of six eight Caravelles and expects delivery of the first of 10 DC-78 plus eight DC-8 and General Electric contracts will acquire a total order of 5103 airplanes, against which advance payments of \$7,911,000 have been made to date.

Delta, which reports on a June fiscal year basis, closed its 1976 operating revenues from \$16 billion in the same period ending March 31, 1976 to \$17 billion for the same period of 1977.

Expenses climbed from \$42.6 million to \$5.4 million and the net income plummeted from \$16 to \$1.5 million.

Northwest Airlines reported an increase in expense to \$12.5 million for the first quarter of 1977 as compared with \$13.3 million during the same period of 1976. Revenue was up from \$16.2 million to \$16.6 million.

The airline's 1976 operating period was slightly from \$13,500 to \$14,700.



CARAVELLE is assembled by crowd after arrival at Miami airport at New York, its second North American stop.

## Caravelle Finds U. S., Brazilian Buyers

New York—Sud Aviation's American sales campaign for its twin jet Caravelle transport is slowly beginning to pay off with the first orders clinched by both North and South America.

Ving, a Brazilian international airline, will probably buy five Caravelles for use on its South American routes to complement a fleet of Boeing 707s planned for its international route to New York. Sud also has an order for three Caravelles from a West Coast airline.

The Caravelle set to purchase the Caravelle will mean that the Brazilian airline has shifted other plans to buy eight Viscount Viscount turboprop airplanes. After recent demonstrations at Caravelle in Brazil included a South Atlantic crossing from Recife, Brazil to Recife, Brazil via Porto Alegre, Brazil via Recife, Brazil.

The Caravelle is to the Viscount as the Caravelle is to the Viscount.

#### 1966 Delivery

Orders will be had been promised 1960 delivery for the Caravelle and added that the Caravelle's 1960 million passenger capacity would pose no problem with arrangements being handled in Europe.

The Caravelle is slowly being to the Caravelle's 1960 million passenger capacity, which average between 650 and 1,300 seated seats, Brno seat.

Study of Caravelle operations over the Vinyr route indicated it would cover at 190 tons with a payload of 12,800 lb and its operating cost per seat mile of 1.3 cents.

At France has ordered 13 Caravelles with first delivery scheduled for the end of 1978 and has an option for 12 under Italian Equinox service with the Caravelle scheduled for 1979 over

At France routes from Paris to Athens, Stockholm and North Africa. All France's first equipment modernization plan calls for a total of 46 Caravelles.

#### Miami-New York Flight

Caravelle made its North American debut with a 2 hr., 41 min. crossing flight from Miami to New York. The Caravelle took off at a gross weight of 90,400 lb and carried 15 passengers, averaging 415 mph ground speed against a mean headwind of eight mph. At the intermediate stop in flight, the Caravelle became the first commercial jet transport to land at Miami's International Airport.

The Caravelle set to purchase the Caravelle will mean that the Brazilian airline has shifted other plans to buy eight Viscount Viscount turboprop airplanes. After recent demonstrations at Caravelle in Brazil included a South Atlantic crossing from Recife, Brazil to Recife, Brazil via Porto Alegre, Brazil via Recife, Brazil.

George H. Bond, president of Sud Aviation and Henri Lavoie, general representative of Air France in North America.

The American test is being made with the second Caravelle prototype fitted with an airline interior meant at demonstrating a high degree of passenger comfort. The Caravelle is to be the quietest and smoothest jet transport to appear to date. It is much quieter than the other jets of the same class than the Victor's Viscount, De Havilland Comet and Boeing 707. There is some engine noise noticeable to take off but during climb the noise subsides and vibration is unperceptible.

#### Engine Improvement

Increased output, a revised cockpit, and more baggage space will be the principal improvements incorporated in production versions of the Caravelle. The prototype is flying with Rolls-

### Caravelle Specifications

(For Production Models)

Maximum Capacity	.....	64 First Class, 31 Tourist
Speed	.....	360 mph
Range	.....	2,330 Miles With 64 Passengers
Maximum Fuel	.....	23,000 gal.
Powerplant	.....	Two Rolls-Royce RR. 29 Avons Developing 11,000 hp Thrust
Fuel Capacity	.....	4,557 gal.
Wing Span	.....	1,600 ft.
Empty Landing Weight	.....	15,500 lb.
Maximum Takeoff Weight	.....	94,000 lb.
Maximum Landing Weight	.....	90,400 lb.
Wing Area	.....	1,121 ft. 6 in.
Over All Length	.....	184 ft. 10 in.
Crewing Ability	.....	20,000 to 90,000 ft.



**SPIN PHASE** of Corelle is partially opened in tests on Long Island. Spins and speed tests had not concluded as Corelle was bunched on runway at LIAW. Large spool blades outside are on underside of spool.

Rover SA 26 Arco's total at 10,900 lb thrust. Production curves for Av Turco are scheduled to get 11,000 lb thrust RA 28, while there is strong interest to meet early the commercial version of Pratt & Whitney's 11,000 lb thrust JT7 as General Electric GE-90 (75) interest total at 12,000 lb for Arco's delivery.

Corelle's engine is designed to handle engine up to 11,500 lb thrust without any major modifications. With 11,000 lb thrust engine the Corelle is scheduled to cruise at 480 mph, with a maximum speed of 523 mph obtainable from the maximum engine installation of 12,500 lb thrust turbojets.

In addition to the possible use of General Electric engines, Avco Aviation has other plans for Arco's engine, including consideration of the concept

by Republic Aviation on Long Island under license and establishment of open order at reduced U.S. contract overhead costs.

#### Comet Nine as Prototype

The work on the two prototype Comets now standard Comet seven sections purchased from de Havilland and spliced into the French design; Red Jet developed new nose with a standard Saabert of Automotive Engineers' attachment point that will be incorporated in production model.

In addition to demonstrations to include at 17 U.S. cities and five South American cities, Red Jet is preparing the executive summary, final cost estimate has been shown to avoid as possible program delays in using the Corelle as a high altitude probe plane.

with a 270° direction in a forward wing seat with a lap belt for restraint. Its fuselage carried 160 in.

Dr. Campbell is not a member of the Aero Medical Association but he has served on American Medical Association and Colorado Medical Society committees during the preliminary development program. He was invited to read a technical paper at the annual meeting and his assistant to submit a proposal to the resolution committee was accepted. Campbell said his proposal to sign upon CAK's proposal for all facing seats has the support of Col. Stapp, Col. Harry G. Moody, Chief of Air Force Flight Safety Research and Dr. Edward Salzman of the Mayo Clinic.

The resolution committee, headed by Dr. Ludwig G. Lofgren, medical director of Capital Airlines, advised in its strongly worded resolution that the issue for general debate be restricted to members. Loftis, who is first vice president of the association, stated the position of the association when he said that if a seat of the Aero Medical Association to ask speakers, or both of government agencies. In place of the Campbell resolution, one was proposed out of committee asking the association to set up a study group to weigh the advantages of all out forward facing seats.

During the resolution, Dr. Campbell criticized Dr. Loftis as a man who is "resistant about today's incidents to do anything concrete about installing all facing seats. He pointed to some British air line deaths using all facing seats in a favorable comparison. Dr. Lofgren replied that he has no one thing that he regards as substantial evidence that the air facing seat offers more margin of survival for the passenger as that it is even the option of the forward facing seat as the respect.

Col. Stapp pleaded for more positive action of any type aimed at improving the non-safety seats.

## CAB Official Denies Northeast 'Leak'

Washington—Raymond Sawyer, executive director of the Civil Aeronautics Board's International Division of the Bureau of Air Operations, "conspicuously" denied earlier news that he passed information on an obscure CAB decision involving a New York-Mexico route to Northwest Airlines.

Earlier, Laurence Henderson, Washington representative of PanAm's Air Lines and Express Co., had testified before the Senate Permanent Investigative Subcommittee that Sawyer was the "probable source" of a "leak" he received on the decision (AW May 3, p. 42).

At the time, Sawyer was executive director of CAB, and Henderson was Washington representative for Texas American Airlines.

The subcommittee is investigating an alleged "leak" of CAB's secret decision late on the evening of Aug. 2. The decision was not made public until Aug. 10. Northwest stock transactions, however, dropped from 500 shares on Aug. 2 to 14,000 shares on Aug. 5.

The subcommittee's aim is that all of this activity can be traced to a greater source.

Robert Oliver, a member of the Washington law firm of Peper and Neal, which represented Delta Air Lines as the New York-Mexico case. Oliver telephoned Henderson on the evening of the secret to Robert L. Criffin, assistant to the president of Delta Air Lines, on Aug. 2. Criffin, in turn, telephoned the information to Robert Stuedel, Republican national commissioner of Mexico, Co., at 8:30 a.m. on Aug. 3. The result was a purchase of 100,000 shares of Northwest stock by Stuedel and his relatives, and later a snowballing of purchases in Atlanta. Oliver's statement was that his information of the secret decision came from an "anonymous telephone call."

Henderson, who telephoned information on the decision early on Aug. 3 to PanAm's chief, president, Boston stock market, and flight instructor, chief of Texas American Airlines both of whom purchased blocks of Northwest stock and panicked another opening movement in the market.

Stuedel, Raymond Bowler, New England public relations man, newly employed by Texas American, and Gilie Long, Washington attorney and owner of San Ramon Long (LA), at the time was prominent in the purchase of the 555 stock in Northwest held by Alan Corp. They plan to release it later on by local New England interests. They were advancing the plan through Clark and his wife, and widely questioned in the area.



**TESTIMONY** of Laurence Henderson stated Board official in public session.



**DENIAL** of Henderson's charge was made to committee by Raymond Sawyer (left).

In affidavits to the subcommittee Henderson stated that he had no "actual" information whatsoever on the CAB decision. In earlier testimony, in public session, he testified that he telephoned Clark and Marine approximately at noon on Aug. 5 to say that Northwest probably had been awarded the New York-Mexico route. He said his information was simply a deduction from the fact that he knew the secret decision was announced and that, during the morning of Aug. 3, he noted a sharp upswing in Northwest trading.

## Eastern Hits Mexico Proposal

Washington—Eastern Air Lines last week launched a strong attack against a recommendation that Pan American World Airways move New York, Washington-Mexico City country as well.

The airline filed 50 pages of objections with the Civil Aeronautics Board to CAB Executive Robert T. Stuedel's recommended decision. Both Eastern and Pan American were applicants for the route.

Eastern contended that the route was departed from the quiet and interest of the recent conclusion of transportation agreement between the U.S. and Mexico by reassigning Pan Am's route. The recommendation, Eastern said, would give greater consideration to Europe-Mexico traffic than to U.S.-Mexico traffic.

The airline said Stuedel's recom-

mendation would subordinate all accepted standards of public convenience and necessity, that it would pre-empt dollars in foreign traffic which does not touch this country under this double U.S.-Mexico traffic which the bilateral agreement contravened, and that the dollar value of the long-haul Mexico-Kanapa to the way a bar.

At the same time, Eastern also complained that Pan American is "unduly interested" in the CAB's present investigation into Pan American's air-coasting and routing proposals (AW May 31, p. 57).

Some of Eastern's charges closely follow an expression of its opinion as the floor of the Senate May 13, in which Senator Milton B. Young, (R-N. D.) and Pan American's position should create status quo pending the outcome of the CAB investigation.

## Medies Hit Industry Attitude

By Roscoe Hendon

Denver—Despite what the aviation industry's executives seemed to be saying in their seats and their cockpits, pilots of both regions was shocked at Air Medals American's annual meeting here last week.

Col. John P. Stapp, director of USAF Air Medical Field Laboratory at Hurler Army Air Force Base, took the audience to task for delving into the subject of air being acts instead of air being positive action to improve the passenger risk and safety seats in the cockpit or in the cabin.

Adding fuel to the fire of the long-standing controversy, Denver physician H. H. Campbell proposed a resolution urging Civil Aeronautics Administration to establish air facing seats in cockpits and requirement for all transport category airplanes.

Dr. Stapp was reported by a local newspaper to have accused the action of being negligent of the safety of that

passenger. He said that his remarks were made in a letter of the industry had been submitted and that he had intended to correct the whole system relative to delving the subject on air and forward facing seats instead of going to the aviation board and improving passenger survival chances.

He said that the principle of progress is failure with the passage of the last law in the aviation field has not yet been fully explored.

#### Seat Loss Less

As evidence, Dr. Stapp cited the fact that aircraft load factors of the range of 100 to 120 percent commercial transports are in crash or three times higher than the ultimate load factor of the seat installed in them. He said that current passenger reliability with the ultimate load of 52G but to take all advantage of the available strength of the human body, and pointed out that as his own laboratory's human subject has

## THE RECORD-BREAKING VISCOUNT



Cubana reports...

## VISCOUNTS BOOST TRAFFIC 119% IN JUST 3 MONTHS!

From Cubana comes further proof of the tremendous passenger appeal of the turbo-prop Vickers Viscount. In less than three months of Viscount service on Cubana's Havana-Miami run "west out" traffic increased 119%. For the month of August, 1962, the passenger load factor of Cubana Viscounts climbed to 87%.

Because of many passengers want to fly "only by Viscount," Cubana's share of market has been increased to the highest level in history.

Such operators and passengers appreciate the quiet of the Viscount. Mr. Juan Pella, Cubana Vice-President, notes that between Havana and Miami, "the Viscount flight time is 55 minutes... the fastest on the route." Therefore other airlines report comparable success with the Viscount fleet. It's practically a rule: "Whatever the Viscount does, traffic follows suit!"

turbo-prop **VICKERS**  
**VISCOUNT**  
POWERED BY FOUR ROLLS-ROYCE TURBO ENGINES

U. S. Representatives: Christopher Chyba, 30 Rockwood Circle, New York 26, N. Y.

## Infrared Seen as Collision Alarm Hope

By Philip J. Kline

Washington—Aircraft industry hopes for a still untested [now-cancelled] primary warning system to ease the air collision problem are being focused on infrared.

Although some feasibility questions remain to be answered, so-called secondary radar could produce an infrared PWT with certain operating limitations, in 12 to 15 months.

It also appears almost certain that a fully automatic collision avoidance system (ACAS) will require development of an entirely different type of system using techniques which require both parties to a potential collision to be suitably equipped before either can be detected.

Because such a cooperative system must be compatible with both civil and military needs, qualified observers believe that the nearest realistic implementation of such ACAS systems is at least five years out.

### Unpleasant Coincidence

There are the hard, unpleasant coincidences causing cut of a three-day meeting held here last week by the Air Transport Association to discuss new ideas and proposals on the air collision problem. The meeting was attended by 125 people, including representatives from major airlines, nearly 18 industry associations, five military units, Air Force, Navy, and several other government agencies.

The ATA meeting heard reports by:

- Three industry manufacturers on possible IR, presently warning systems. These included Fairweather Electronics, Nevada Air Products and Lockheed. A representative of Aircraft General, major infrared sensor producer, discussed IR techniques but did not reveal details on the PWT which his company is co-developing for other air installations, including Arco, Eastern, Kogal, Hilde, Braniff and Boeing, Perlin Elmer, Santa Barbara Research, and Texas Instruments, also attended.

- Bendix Radio on its collision avoidance system study-development contract for USAF's Wright Air Development Center.

- Boeing Airplane Co. on its own research study of the collision problem and manufacturer's view for a specific cooperative system which it believes will accomplish the job for airlines by the '70's.

- Raytheon on its equal radar view on what they would like as PWT and ACAS have reached long talks on such final studies of the problem by Bendix Radio, Boeing, Collins Radio,

and Hughes Aircraft. These have revealed the extreme accuracy with which bearing and closing rate measurements must be made to insure high probability of detecting potential collisions without frequent false alarms that could be equally disruptive.

Current infrared views, which will be set forth later this month at a new ATA symposium, can be summarized as follows:

- Presently warning indicators, which would automatically alert pilot and tell him where to look for an intruder, could greatly ease the present collision problem but would not fully solve the problem.

- IR could relief it to be hazardous. PWT must be a self-contained, non-cooperative system which patterns an plane on which it is installed search itself without having to wait for other airplane users to install PWT equipment.

- All-weather vision is desirable for a PWT but airlines will accept one whose vision is limited to what the pilot can see when desired. Additionally, the PWT should not cut through an area where vision through clouds. (There is growing concern that weather radar, by showing pilots narrow corridors of new turbulence through a storm, may cause traffic into such corridors and lead to collisions.)

- Cooperative type system automatically will be required for fully automatic collision avoidance system. Its present development of an installable PWT, airlines are willing to keep operating until that PWT is capable of going into an ACAS.

- Civil and military collision avoidance system will be compatible with the one aircraft must carry both systems.

This would place an impossible one-way weight burden on many military aircraft and serious economic burden on civil aircraft.

To assure compatibility, the civil systems design can not be hampered until the military design is fixed, and this could take another two years. The military position, which Bendix is studying, is extremely difficult since the ACAS must cope with the threat of head-on collisions between two Main 1 aircraft.

The Boeing contract calls for them to deliver research results in 12 months, indicating that the testing of the USAF system design could take 24 months.

Another representative at the ATA meeting, once once expressed with the possibilities of infrared tests with the specific preliminary proposals presented by any of the manufacturers, who were

unable to give more than rough estimates of possible infrared PWT system performance.

Recently generated evidence of the performance of specific military IR systems. Another reason is that the usage of such an infrared PWT can include detection of aircraft depends upon many factors. These include: weather conditions, altitude, aspect angle of the intruder, whether it is a propeller-driven or jet aircraft, and other factors determined by the specific aircraft type.

Because most military IR systems are designed to see against jet aircraft, they appear to be limited often on the IR collision from, pilots engage an aircraft during these low-altitude, low-altitude experts made the following qualified predictions about the maximum range of an infrared PWT:

- More than three miles, with probability of better than 90% above 30,000 ft altitude, if weather is good enough for pilot visually to see target at the distance. Prediction came from Richard W. Trowell of Aircraft General.

- Two to eight miles, with minimum, if clear weather and daylight, depending on altitude upon target according to Dr. W. K. Kneiss of Rockwell.

- 20 miles maximum, with 90% probability, above 30,000 ft in fair weather, according to W. E. Osborne of Nevada Air Products.

Experts at which said no infrared PWT system might work ranged from about 20 to 100 miles depending upon the terrain and installation.

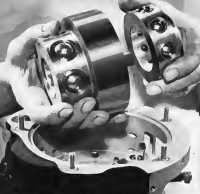
### Naval Approach

Perhaps the most novel infrared PWT system comes from the Bureau of Naval Weapons where officers proposed to detect the IR solution from an extending airplane engines or jet exhaust. Raytheon proposed to detect the modification of infrared radiation in the atmosphere caused by the airplane's propellers or the turbulence produced by jet engines.

Kneiss reported that Rockwell has detected a line signature unique to the sea at distances where the craft was not visible to the human eye using a heat-pipe telescope. The test was run with very simple experimental equipment.

Another representative of the Rockwell proposal was to implement IR detection equipment with a dual-channel TV camera connected to the tail. When the PWT had detected an intruder and alerted the pilot, he could automatically position the tail-mounted camera for a look at the intruder by pushing a button on the PWT display.

Infrared experts concluded that there



**MCHANICALLY LIGHTWEIGHT** ball piston unit shown being assembled on 30 KVA drive is conventional cylindrical piston, containing rods and bearings. Its use results in a more compact, lighter weight constant speed drive with fewer moving parts.

#### GENERAL ELECTRIC DEVELOPMENT SHOWS

## How Ball Pistons Cut Size and Weight, Simplify Hydraulic Drive Design

General Electric Hydraulic Constant Speed Drives offer extraordinary speed and weight savings and design simplicity for any 400 cph-a-a electric system. You can combine these drives with any aircraft generator for use on piston, turboprop, or turbojet engines.

**UNIQUE BALL PISTON DESIGN** is the key to the small size, lightweight and mechanical simplicity of these drives. Operating on the principle of precession, the rod ball piston hydraulic transmission unit precesses steel balls in place of pistons, one-way rods and bearings. Extensive test, up to thousands of hours of operational flying, have proven this most advanced high efficiency and reliability.

**FEWER MOVING PARTS** are required with

this design. For example, since the balls are free in the cylinder and roll on the rods, no separate bearings are needed to give constant rotation, and the seal pistons and connecting rod bearings are eliminated. The use of a geared bearing further cuts size and complexity. What's more, the mechanical governor system, which provides steady state speed control within  $\pm 1\%$ , is an integral part of the transmission. Ready-replaceable parts simplify maintenance.

**COMPACT AND SELF-CONTAINED**, a typical 30 KVA drive measures only 21 inches long and 9 1/2 inches in diameter. It weighs 35 lbs. A typical 48 KVA drive measures 21 inches by 11 inches and weighs 22 lbs.

*Progress is Our Most Important Product*

**GENERAL ELECTRIC**



**LIGHTWEIGHT 30 KVA DRIVE** weighs 35 lbs. It delivers rated 30 hp over full speed range of 4380 to 4500 rpm.



**COMPACT 48 KVA DRIVE** weighs 22 lbs. It delivers 48 hp over full speed range of 3780 to 4000 rpm.

**GENERAL ELECTRIC**

fine frequency control to  $\pm 1/10\%$ , and automatic paralleling can be provided with all General Electric Hydraulic Constant Speed Drives. For more information on these drives contact your General Electric Aviation and Defense Industries Sales Office, or send coupon for literature.

Circle 10 on Reader Service Card  
Sincerely, S. New York

Please send me the following hydraulic transmission literature:

- descriptive bulletin, SEA-4274
- history of development, SEA-5888A
- immediate project, CH-5888A

Name \_\_\_\_\_

Position \_\_\_\_\_

Company \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

might be problems in detaching an air-tender coating from the direction of the sea and that other industries from ground objects would pose false alarm problems.

One way around these problems, which would also extend the useful range of an infrared FFW, would be to go to a non-cooperative system where the aircraft installed one of two craft, low seat IR beams, visible to the Covert Looking Lights now used. This might permit an infrared FFW system to have greater range than a cooperative craft, better range against equipped airplanes.

Another possible non-cooperative FFW system suggested would use weather and navigation radar sets installed on many and not radars on itself. The installation of radar beams would permit an intruder in the forward hemisphere to be detected and classified on radar-equipped aircraft.

A problem arises because radars use two different radar frequencies (X band and C band) and the military use still others. This would require such advance technology as the use of the long wavelength operation in early 1959. Employment of certain techniques and devices could possibly reduce the noise level below that created by jet engine exhaust.

#### Using Precept

In reviewing the AGAS which Boeing has designed on paper to meet the needs of military aircraft, the author has emphasized that his concept has an intrinsic of building such a system and made hopes to stainless steels as well as being.

The Boeing AGAS employs an extremely high frequency (15,000 mc) radar with one antenna mounted to the nose, the other in the tail. These are synchronized to provide full 180 deg. azimuth surveillance, one vertically, one horizontally. The nose antenna radar antenna would be mounted back-to-back with the tail antenna radar antenna.

Compensating aircraft would have to have small radar beams (smaller than those planned for radio directed transmission) and fast operating at a different frequency. The beam on an intruding aircraft within the  $\pm 18$  deg vertical coverage would be intercepted and visible to the air-collector radar.

This would provide the AGAS with data on jet engines which could be obtained in its range and closing rate. Use of V-beam antennas as the surveillance radar would also provide data on the intruder's vertical position. This information could be displayed on a cockpit radar scope and also mounted by a digital computer.

If these intensive interrogations

showed that intruder bearing was essentially constant and its range decreasing, a collision threat would exist and the pilot's radar would flash as to the pilot's direction. It would also show distance and direction of required evasive maneuvers.

Interference coverage outside the vertical coverage of the non-cooperative radars would come from conventional antennas mounted on and underneath the fuselage. These would also intercept the intruder's beams, also to indicate when the intruder came within 5,000 ft, and show the intruder's range and above-below location but not at exact position.

## Airlines Say Jet Noise to Be Cut To Reasonable Level by 1959

By Ford Entzman

Chicago—Airlines say they are confident commercial jet noise can be limited or reduced to a point where it will be acceptable at managed airports and in residential areas by the time the jet begins operation in early 1959. Employment of certain techniques and devices could possibly reduce the noise level below that created by jet engine exhaust.

Latest developments and work of test made as noise control were outlined at a meeting of the Ground Equipment and Maintenance Facilities Subcommittee of the Air Transport Assn.

Delegates pointed out that the major problem is the need for additional suppression of jet engine noise in the metropolitan areas where jet power may be applied for short periods of time. Jet engines are scheduled to be equipped with suppression to reduce noise during normal operation. The major problem will be the high frequency noise from the engine jet intake when running at low speeds such as taking to and from airport gate positions. In some cases, exhaust blast may also create a problem.

The big question, however, is to what extent noise will have to be suppressed in order to provide assurance.

While the acceptable noise level is determined in airports and the surrounding areas, these steps will be taken to meet the requirements. Engineers claim that substantial noise reduction of noise reduction in the operation of jet engines will be obtained. It depends upon the amount of money to be spent for the purpose of the acceptable noise level list can be tolerated.

The two main sources of noise in a jet engine are from the exhaust and intake areas. At high engine speed, most of the noise comes from the ex-

hauster's edge and above-below location but not at exact position. Airlines interest in the Boeing system appears to be the highest. Although Boeing's William Hawkins and the company has made no size or weight estimates, observers predicted that it might weigh more than 100 lb., cost more than \$100,000 per installation.

Furthermore, the weight of a 15,000 mc radar, even with protection, is somewhat reduced as better processing techniques allow observers believe that Boeing noted to become sufficiently heavy install.

latest, while at low speed the air intake with a high frequency noise that may be significant at close range.

Various methods have been developed to eliminate both, but the most universal methods of reducing noise now available is a corresponding loss in engine operating efficiency. A compromise is being sought between the cost, size, and weight and acceptability and an acceptable noise level in the metropolitan areas.

Other factors also may aid in eliminating noise, Exhaust noise is a large engine disturbance, mostly confined to an arc directly behind the pipe. Encasing the backings and screens will have an insulating effect.

Therefore, if it is possible to conduct an up-test with exhaust pointed toward sparsely populated areas, it is possible that no suppression would be needed.

Delegates generally believed that, if jets are to be used to and from terminal gates under their own power, additional noise will have to be taken for the position of passengers at the gate and within proximity to the runways in addition to the high frequency noise—radar filters results to passengers could become a problem at some point.

Use of barrier fence between gate positions have provided the best means thus far. A substantial reduction of noise has been achieved, and the blast effect against persons behind the barrier or landing aircraft at adjacent gate positions has been practically eliminated.

The fences are constructed to stand at an angle to the runway so that the blast and noise is deflected upward. This is extended on both sides of the gate and stretched out onto the apron.

A drawback to this method, however, is that it controls noise only gate position, and noise produced surrounding an aircraft at jet gate must go around the fence to reach the seat.

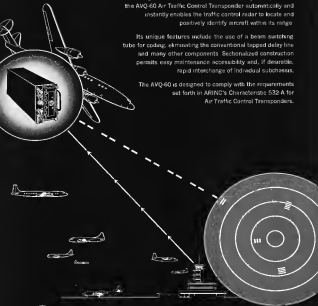


# AVQ-60 AIR TRAFFIC CONTROL TRANSPONDER

Designed for airline, business, and military transport use, the AVQ-60 Air Traffic Control Transponder automatically and instantly enables the traffic control radar to locate and positively identify aircraft within its range.

Its unique features include the use of a beam switching tube for coding, eliminating the conventional tapped delay line and many other components. Sectionalized construction permits easy maintenance accessibility and, if desirable, rapid interchange of individual subassemblies.

The AVQ-60 is designed to comply with the requirements set forth in ARINC's Characteristic 532-A for Air Traffic Control Transponders.



Custom Aviation Equipment

**RCA RADIO CORPORATION of AMERICA**

11819 W. Olympic Blvd., Los Angeles 64, Cal.

## SHORTLINES

► **National Airlines** says it cannot open into Boston and water without "adequate larger facilities" at Logan International Airport. Alexander H. Hahn, National's senior vice president, told the Massachusetts legislature that last winter the airline was forced to cancel flights because there were no berthing at Logan for the carrier to overnight its *deco* aircraft. Hahn said National would be willing to enter into a lease for larger facilities at no cost to taxpayers if the legislature would pass a bill authorizing construction of a larger terminal.

► **American Airlines** and **United Air Lines** have begun operation of a mutual teletype exchange at Chicago for simplifying airline communications. Using the system, an agent sends an airmail message request to the mutual teletype exchange at Chicago where it is automatically relayed to the communication equipment of the other airline and transmitted to the desired city. Space reservations are handled in the same manner.

► **Inland Airlines** (I. A. L.) increased its scheduled operations between New York and Chicago to daily flights on May 31. The new service, leaving New York on Tuesdays, provides a second weekly flight to Chicago, Scotland, and on to London. Roundtrip fares are at \$495.00 during the summer season.

► **United Air Lines** has contracted agreements with 16 cities in the Americas and National has built airports through which passenger service "one-half mile in size along the United system. Co-pilot used by the airline can be exchanged for tickets at "full rate" windows at the full price.

► **Swire** will begin Douglas DC-7 service on two of its South American routes beginning July 9. The new service, one weekly from Zurich to Buenos Aires and once weekly from Zurich to Sao Paulo, will replace Swire's DC-6B service. The Buenos Aires flight leaves every Sunday; the Sao Paulo flight every Thursday.

► **Trans-Canada Air Lines** will begin nonstop Lockheed Super Constellation service between Toronto and Vancouver on June 1. TCA's flights are the new service, combined with additional services out of Montreal to the Atlantic Coast provinces and an increase from six to 12 transatlantic flights, will give TCA 349 more passenger carrying capacity on its new summer schedule.

## AIRLINE OBSERVER

► Airline pilots are complaining that lack of remote radio stations at the Midwest air route traffic control center are causing no-fly alerts at 45 points. Pilots point out high-performance aircraft are often required to circle over while waiting for clearance to continue because of fuel-air communication. Although the center will handle as many as 5,500 fly postings on a busy day—compared with 7,000 at the Washington center—all radio contacts are relayed through company radio. The center is without radio equipment and there is no urgent need for it at least two more VHF frequencies, pilots say.

► **Leading fees at British airports** will be increased by 35% effective June 1. Hanger rental and parking charges are also likely to be increased at a later date. Action follows criticism in Parliament of financial losses at many British airports.

► **Soviet government** has agreed to accept a permanent representative of Air France in Moscow. Only other non-Soviet airlines with representatives in Moscow are Scandinavian Airlines System and Fines, both of which fly directly to Moscow from Scandinavian ports. Noted by the report by Air France is Moscow-opening M. Elie Toffier, a direct relative of the Russian Russian aviation. Soviet talks between Aeroflot, Soviet-owned airline, and Air France for a Paris-Moscow-Paris service were suspended last fall because of the Khrushchev crisis.

► **New law** last year leased 25 aircraft to commercial airlines to bring the Navy's total fleet to less than 27 for an annual saving of \$1.4 million.

► **Swif Airlines** will spend up to \$1.5 million on its U. S. guarantee of the Capital City transport. This amount has been budgeted by George H. Brown, *Swif* president, in his battle to sell the Patrick transport to carriers in the U. S.

► **Capital Airlines** and the International Assn. of Machinists reached an agreement after a six-day 18-hour, although awaiting to avert a threatened strike. Wage loads were less 15 cents per hour for cleaners to 21 cents for mechanics and 24 cents for carpenters and lead mechanics. The union asked 23 cents for mechanics, Capital offered 23 cents below the compensation, 21 cents was reached. The airline also agreed to settle immediately a total of 174 grievances filed against it. Pay raises are automatic to Dec. 1. This will cost the airline approximately \$475,000.

► **U. S. District Court** in Cheyenne, Wyoming, has ruled that airlines cannot be held responsible for failing to complete or freight shipments according to published timetables. The decision was the result of a civil suit brought by a *Boeing* transport *Frontier Airlines* for failure to deliver a heavy equipment item *Los Angeles to Lawrence, Wisconsin*. *Frontier* was excused because of weight limitations. Federal judge ruled that a "contract carrier" no obligation to commence or complete transportation within a certain time.

► **International Civil Aviation Organization** has allocated \$1,365,000 for its 1957 technical assistance program as compared with \$4.2 million in 1955 and \$294,175 in 1954 when the program began. Bulk of 1957 funds have been reserved for airport construction and maintenance of technical facilities in Near and Far Eastern countries.

► **Northeast Airlines** has extended its daily line rates to include Saturdays to compete with the Capital Airlines rate which became effective when the allowable suspension period of 180 days was allowed to elapse just to a Civil Aeronautics Board investigation (*AW* April 22, p. 47). CAB found that the adjusted rate may be "input and unactionable" but added that "it would be responsible to suspend Northeast's proposal on Capital Airlines' already permits fairly but on Saturdays from and to many points served by Northeast."



**FIRST  
NONSTOP  
SERVICE  
between CLEVELAND  
-LOS ANGELES**



Only American offers nonstop service between Cleveland and Los Angeles—almost an hour faster than any other airline. You fly American's famous DC-7 Mercury, the luxury leader in the world of flight.

**AAA AMERICAN AIRLINES**  
*America's Leading Airline*

## Airline Income and Expenses—February 1957

(In Dollars)

	Passenger Revenue	Mail Revenue (in \$)	Express Revenue	Freight Revenue	Total Operating Revenue	Total Operating Expenses	Net Operating Income
<b>DOMESTIC TRUNK</b>							
American	219,375,627	200,273	233,744	21,191,679	220,999,923	211,379,374	966,549
United	4,432,614	113,840	87,722	19,202	4,643,480	4,672,849	486,238
Continental	1,466,791	79,084	46,281	40,426	1,732,582	1,746,327	161,857
Eastern	1,326,623	39,479	9,713	1,471	1,477,391	1,506,416	44,319
Delta	4,373,807	120,884	96,420	128,247	4,720,358	4,749,873	15,105
Northwest	79,740,123	206,243	823,217	—	80,769,683	80,915,712	1,116,952
TWA	1,561,413	19,703	34,500	334,709	1,640,325	1,740,074	(99,749)
Southwest	326,209	5,714	4,419	15,893	352,235	1,139,406	(787,171)
Midwest	2,242,726	122,847	272,225	—	2,637,800	2,644,471	(6,671)
Trans-Mt	10,433,104	326,343	291,977	—	10,951,424	10,955,398	(3,974)
Wetair	17,441,127	692,499	217,400	771,467	19,123,493	19,124,193	(700)
Western	1,729,891	39,313	34,118	27,463	1,791,785	1,829,163	(37,378)
<b>INTERNATIONAL</b>							
American	494,621	4,691	127	40,466	539,905	512,113	27,792
British	434,874	19,243	—	37,739	491,856	414,863	76,993
Continental	492,001	—	—	—	492,001	511,111	(19,110)
Delta	484,873	4,623	—	14,713	504,209	506,191	(1,982)
Eastern	1,143,736	29,218	17,729	—	1,290,683	1,371,323	(80,640)
Northwest	—	—	—	—	—	—	—
Southwest	515,124	449,494	206,124	—	1,170,742	1,461,164	(290,422)
TWA	191,000	14,800	27,000	—	232,800	232,800	—
Western	2,341,040	27,260	891,000	—	3,259,300	3,424,100	(164,800)
Alaska	3,317,000	144,000	1,170,000	—	4,631,000	4,666,000	(34,000)
Delta	3,819,000	417,000	643,000	—	4,879,000	4,897,000	(18,000)
Eastern	3,272,000	26,200	—	129,774	3,428,000	3,499,200	(71,200)
Trans World	3,657,000	375,274	—	—	4,032,274	4,032,274	—
United	619,000	90,400	361,000	14,700	1,085,100	1,114,100	(28,000)
<b>LOCAL SERVICE</b>							
Allegany	215,023	4,409	10,128	3,728	233,288	442,841	(209,553)
Revenue	147,349	3,749	1,470	3,620	166,188	163,154	3,034
Central	42,303	9,917	1,184	2,000	56,404	57,600	(1,196)
Aviation	322,610	337,267	3,379	16,779	670,035	717,401	(47,366)
North Central	301,302	2,708	4,644	—	308,654	320,708	(12,054)
Midwest	—	—	—	—	—	—	—
South Central	464,192	15,099	11,418	—	490,709	502,908	(12,199)
South	236,602	190,187	3,284	2,042	432,115	432,115	—
Piedmont	264,120	6,209	2,548	2,927	275,804	278,120	(2,316)
Southern	141,293	7,099	9,361	—	157,753	168,008	(10,255)
Southwest	—	—	—	—	—	—	—
Trans Texas	346,159	6,121	3,464	6,941	362,685	365,176	(2,491)
West Coast	943,629	2,468	1,134	1,110	948,341	971,663	(23,322)
<b>NEWARK</b>							
Terraviva	876,344	2,469	2,742	26,420	907,975	913,629	(5,654)
Trans Pacific	133,129	—	—	—	133,129	133,129	—
<b>GASB SERVICE</b>							
American Del-América	—	—	—	—	—	—	—
Flying Tiger	36,727	3,426	711,769	—	751,922	754,749	(2,827)
Alitalia	—	1,740	262,548	—	264,288	270,289	(6,001)
Swire-Norfolk	—	—	—	—	—	—	—
China	—	—	—	—	—	—	—
<b>REGULATED</b>							
Chicago-Milwaukee	4,764	47,463	—	—	52,227	52,227	—
Los Angeles-Phoenix	12,123	7,217	4,263	—	23,603	23,603	—
New York-Atlanta	23,794	3,711	1,408	3,214	32,127	33,126	(999)
<b>ALASKAN</b>							
Alaska Airlines	19,043	19,327	47,229	—	85,599	83,861	1,738
Alaska Coastal	15,371	8,412	—	4,424	28,207	28,207	—
Alaska	—	—	—	—	—	—	—
Pacific Northwest	103,204	28,546	41,207	—	172,957	172,957	—

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

†—Total property expense, net of depreciation.

\*Not available.

†Not operating last offer lease.

‡Not operating last before lease.

§Not operating last before lease.

¶Not operating last before lease.



## North American (Model 249)

### T2J-1 Specifications

© Westinghouse 24-95-46 © 3,400 lb. thrust

Maximum gross takeoff weight ..... 3,207 lb.  
 Maximum speed ..... 41,500 ft.  
 Maximum speed ..... 407 kt.

Wing  
 Total area ..... 815 sq. ft.  
 Tip area (total) ..... 21 sq. ft.  
 Airfoil area (total) ..... 715 sq. ft.  
 Airfoil area (tip) ..... NACA 44012E and

Reinforced tail  
 Total area ..... 54 sq. ft.  
 Reinforced area (total) ..... 37.44 sq. ft.

Vertical tail  
 Total area ..... 35 sq. ft.  
 Reinforced area (total) ..... 26.71 sq. ft.

**FULL-SCALE MODEL** of T2J-1 (above) shows big tail providing good forward visibility, the large amount of under-bay volume for possible equipment mounted in open. Cutaway (right) details carefully placement of equipment and space for ease of maintenance. Illustrates air intake flow ducting, is second strand of wing leading edge to give low wing visibility steps.

## T2J Designed

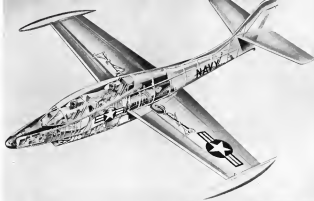
by **Ervin J. Rubin**

Columbus, Ohio—North American Aviation's new T2J-1 two-place jet trainer is designed as a complete pilot training system, capable of taking the pilot from primary through advanced phases including Navy carrier indoctrination.

Versatility of the airplane—due to be widely evaluated, engineered and produced at NAA's Columbus Division—is such that it could serve at least a month from carrier student training program, which involve switching to several types in the course of normal circuits. Present line of use is becoming familiar with each airplane will be eliminated, according to company personnel familiar with the T2J-1. They claim it is the first U. S. jet trainer with such capability.

### "Substrated" Control

It is on this item, and with a Navy contract for a "substrated" number of T2J-1s on its books, that North American is seeking a wider scope abroad this month to negotiate additional contracts



## as Primary-Through-Advanced Trainer

with literally dozens powerplants. Initially, the decision team, comprising Fred G. Campbell, director, development and planning; F. W. Howells, manager, technical sales and Lynn Helms, technical sales representative, trainer aircraft, will show a model of the T2J at the Post Air Show late this month.

No firm strategy is planned by the sales team, although it plans to have discussions with West German air force leaders and deliver any leads established during the air show.

### Fight This Year

A trip to England is also planned, where the team will talk to British about application of the Olympus turbojet to the T2J. NAA already has submitted bids to Royal Canadian Air Force and plans to make proposals on an Olympus-powered Model 249 (company designation for the T2J) to RCAF, which is studying several jet trainer projects.

NAA already has made overtures to USAF. The full-scale T2J-1 mockup at Columbus has been studied by the Air Force.

First T2J-1 is scheduled to fly by the



**STUDENT'S COCKPIT** (mockup) can be fitted with engine control pedestal status statement panel.



To owners and operators of Pratt & Whitney powered aircraft:

## THERE'S NO SUBSTITUTE FOR DEPENDABILITY

To be certain of receiving genuine factory parts for your Pratt & Whitney Aircraft engine, see a factory authorized distributor who will supply engine maintenance or overhaul.

These approved distributors, located nationwide in all parts of the country, keep complete stocks of factory parts, and have the facilities, skilled personnel, and up-to-date P&W instructions to give you the best possible service.

To assure the best performance from your Pratt & Whitney Aircraft engine, see these P&W distributors:

### ARMED CORPORATION

Richard Albert, 101-10, N. J.  
Division of Newark Airport, N. J.  
151 N. Main St., College Park, Ga.  
1242 Northwood 24th St., Miami, Fla.  
5811 Eastway Rd., Dallas, Texas.  
Alhambra, Va.

### WESTERN AIRCRAFT COMPANY

Warren Park, St. Paul, Minn.

### PACIFIC AIRCRAFT CORPORATION

Peabody, Calif.  
Branches at: Boeing Field, Seattle, Wash.  
Caldwell International Airport, Calif.  
Daytone Airport, Denver, Colo.

### SOUTHWEST AIRCRAFT COMPANY

Irwin Field, Dallas, Texas

**Pratt & Whitney Aircraft**

Division of United Aircraft Corporation  
East Hartford, Connecticut



**HARNESS** straps out for ground checking. There is sufficient room in the cockpit seat for overhead to check status of jet engine compressor blades.

70 in., and a chute larger than that used on the Martin-Baker seat enables more positive operation. Airframe Wren was told in addition, seat ribs and head rest were narrowed to approximately 9 in. width to give the instructor a clearer view forward. Instructor's forward view is further enhanced by joggling floor at the rear cockpit upward so he sits 10 in. higher than the student.

A large tail was used to provide good stability and positive control at low speeds. NAA studies indicated that approximately 20% of USAP and Navy aircraft accidents occurred during landing and takeoff and of these, 94% could be attributed to loss of control.

Horizontal tail was selected long to minimize buffeting. Good spin recovery is provided by placing the center of the stabilizer below the horizontal tail to prevent it from being effectively blanketed.

Simple, hydraulic boost system for controls, utilizing 1,000 psi is used on ailerons and elevators, with rates of 12:1 and 13:1 respectively. Rudder is full manual operation. Another 3,000 psi system takes care of the 9 in. x 2 in. landing gear linkage, hydraulic landing gear and nose steering gear.

Control boost system is tied out so that some hydraulic capacity is fed back via portair to give other tail hydraulic pressure. GE oil, vacuum applied to the boost cylinder air machine, is fully transmitted to most of the controls. NAA Columbus plans to provide boost switch-off from the cockpit so that students can be given training to land the airplane without it on.

Wide range of mission capabilities planned for the T2J includes initial landing, maintenance, corrections, formation, maneuvers and pilot proficiency training. As one NAA spokesman put it, "This airplane is designed to take everybody, from cadets to commanders."



**COMPARTMENTED** equipment by its own panel opened by pushing two lock-type buttons. When closed, panel seals off one personnel from each other.

For combat crew training the airplane will be capable of providing gunnery, rockets, bombing and two target missions. Designed to operate without restrictions in any configuration with or without hydraulic, the T2J will also be capable of simulating typical weapons delivery techniques. Typical weapons packages designed for it include gun pods, low target pod, 100-lb practice bombs, M-1 practice bomb cluster, T-28 practice bomb container, 125-lb rocket launcher assemblies and 275-lb Mighty Mouse Area SA rocket pods.

As part of the T2J pilot training system, NAA has developed a closed circuit instrumented TV ground instruction monitor (Nigam), which provides the instructor with a constant picture of the cockpit of the student just through his front windscreen, including sight circuits. This non-occluded picture allows the instructor to check the student's progress constantly during weapons firing runs and give help if needed.

Considerable time saving as well as more efficient instruction is expected using Nigam over conventional ground instruction where the student must wait processing and projection of his best learning results and assessing his technique.

Maneuverability around ground at bottom in the T2J ground Mopex future use was providing a landing structure from which equipment and personnel are suspended independent of aircraft maneuvers.

Horizontal stabilizers, elevators, ailerons and trim tabs are interchangeable from side to side, main landing gear interchangeable at install. Air control systems or tabs can be changed without disturbing the control rigging. "Large boys, on left and right sides, have equipment in compartments area that are sealed which prevents air transfer. One large pod, hold in

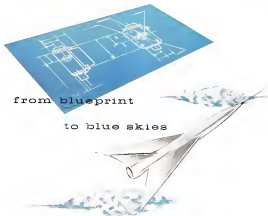


## COSTS OUGHT TO COME DOWN

As America's missile and nuclear programs progress from the experimental to the production stage, cost must necessarily be a big factor. Many missiles and rockets are expensive, one-dollar items. They, too, make cost a more important factor. America's Welding's unique design of flame, hot-weld and decrease range, variable components and other production parts is the answer to production costs.

The further industrialization, research and Industrial Products Division of The American Welding & Manufacturing Company.

THE AMERICAN WELDING & MANUFACTURING CO.  
422 Pike Road  
Mevine, Ohio



from blueprint

to blue skies

From design concept to volume production, Moog's controlled use of high performance electro-hydraulics has been critical. Originally an off-line-labored "needle-dipper" and of dry-water servo valves", Moog alone has been able to translate these concepts into full volume manufacture. The 40,000 units in the field verify a production record unmatched in the industry. Control Moog if you lead of design-to-production performance is desired.

Circle 10 on Reader Service Card



ELECTRO-HYDRAULIC SERVO MECHANISMS

MOOG VALVE CO., INC. FROBER AIRPORT, EAST AUBURN, NEW JERSEY

Research Laboratory, Perkasie, New Jersey



MAN gets ready for 12-4 ft load

Two quick-opening pressure locks, completely bypass all equipment to each bay. Engine bay is totally covered by a single large panel on each side.

Layout of engine compartment in left and right-hand bays is such that wiring from console in cockpit above leads directly downstream to the appropriate bay on the same side in the console, making for minimum length leads and facilitating visual tracing and trouble shooting by maintenance personnel. Only wiring that runs laterally, according to NAA, is that to the lights in engine bays. These bay-out puts a c.c. engagement on the right side and d.c. on the left.

Additional equipment, such as fuel control in advanced landing system can be bay-mounted in the bay-out nose for quick removal and replace ment.

Fuel and oil lines on the left-hand side between compartment and engine bays. Fuel system will take either single or pressure loading.

Engine suspension brackets power structure also makes for speedy removal. In test on the mock-up, the J14 was removed, using a modified Foster bench dolly. Engine island type was never skinned, replacement 12 minutes.

Main fuel tank, containing 500 gal., is directly over the engine and if load pumps should give out, given flow and engine reaction would be sufficient to provide military power up to 12,000 h.p., according to the contractor.

Deposits of 100-gal capacity each being total fuel to 500 gal. allowing a range of 540 statute miles. Four-time fuel-to-air-to-gal burning cycles can be made without external fuel. The turbine fire-quenching system, which is military power for one-half minute, five minute cruise at sea level and 900

feet and fuel allowance after the fuel burning.

The J14 is designed to take off and clear a 50 ft obstacle in 2,000 ft. Landing requirement over 50 ft is structural at 1,500 ft.

Fuselage structure is a monocoque comprising four main longitudinal members and the vertical stabilizer. Flooring starts at the nose compartment, runs through the cockpit area below the fuel tank and ends at the ceiling of the engine bay. Floor deck ranges from 240 to 605 aluminum alloy except in the engine bay area, where it is stainless steel. Lower fuselage skin

also is stainless steel in the engine bay area. Finishing will be performed in three main sections: cockpit, intermediate section, containing fuel bay, power plant area and wing carry-through structure, and the aft section. All construction is production quality.

Two large aluminum forged beams go through the intermediate fuselage. Wings are attached to these by four main body and a drag bolt on each side. An I-beam at the belly, forward of the engine section, carries outboard and tow-logic loads. Loads from these feed into the I-beam, into the periphery of the two engine air intake ducts, and from there to the floor.

**target bearing 095°  
...range 1,500...**

**speed—  
270,000  
m.p.h.!**

Guided missiles of the future are in development today. Also in the pipeline is an amazing new ECM Navigator developed for the Air Force by Halcrafters EDA.

Designed for advanced study of jamming, deception and counter measures techniques, the device functions in the EPI range and simulates all moving targets, and jamming, in actual operation.

Progressive may be considered according to predetermined plan, or targets may be controlled manually. Speeds to 270,000 in p.h., no maintenance, electronic and changes, now can be simulated the planning computer's countermeasures.

ECM Navigator is another example of electronic design/development that has made Halcrafters a prime source of key military projects for over 32 years.

Theough gets out of the ground in a hurry at

**hallicrafters**

4401 W. 5th Ave. • Chicago, Ill.  
\*Equal Development Assistance

# Sagittario Bids for Light Fighter Role



PIVOT TYPE axle uses Pratt & Whitney D-2800 engine in Sagittario II fighter.



ENGINE exhausts in rear and exhausts under belly. Lightest nose section.



STAINLESS STEEL exhausts aft of tail pipe enables faulage from jet blast.

**Race-Airer Sagittario II**, originally classed as an experimental aircraft, has become another entry in the European list of high-speed light fighter planes designed for accuracy and ease of production by nations with limited resources.

The incoming Italian design with a 45 deg. leading edge, sweptback in standard, has evolved into the Mach 1.2 installation of the Pratt & Whitney D-2800 engine in the nose and low-pressing use of stress and maintenance. This also makes for heavy pilot accommodations and ample space for fuel and structure.

## Light Engine

Use of the D-2800 16 cylinder of 2,000 B. H. P. output, providing 1,400 lb. more than the present engine, is possible if the latter could engine into early production.

Sagittario II is convertible in order of the mission.

- **Des. maneuvering**, with high rate of climb and smaller fuel and structural load.

- **Tactical support**, with increased speed and maneuvering, and additional fuel reserve for longer operating altitude and combat flexibility.

Airplane is stressed to withstand an ultimate load factor of 11. Aluminum alloy of high strength is used (Super-wood and light).

Cockpit, arranged on rear hinges, is positioned and equipped with a Martin-Baker ejection seat.

Horizontal tail surface is composed of a single piece structure which carries the tricycle and an elevator made up of two parts. Stabilizer is hydraulically actuated and can be connected with the stick in order to obtain an element control with the elevator.

Exhaust from landing gear with liquid spring type shock absorber is used.

Armament consists of two Hispano-Suiza guns (30 mm.), mounted forward of the wing wing.

## Wing Structure

The overhead wing carries through the faulage and is constructed by a 45 deg. sweepback at leading edge, a low aspect ratio and laminar airfoil.

Skewed type airfoil was so determined to insure a good lateral stability even at high speeds. They are longitudinally and vertically balanced and are controlled by means of a Finlay hydraulic booster. Immediately forward of the ailerons, and in line with these ailerons, are the spoilers. They are synchronized with the ailerons.

Flips are at the slotted type and ex-



BASIC CONCEPT of Italian fighter is simplicity. Engineering is for production ease for nations with limited resources.

posed from the wing root to the ailerons and are hydraulically operated.

Installation of the engine in the nose makes for a structural design similar to that of piston engine powered aircraft. Faulage is built in one piece including the fan. A ballhead secures the engine nose from the cockpit.

Behind the cockpit are first the gear and ammunition bay compartment and next the main fuel tank, winged with the faulage structure and secured by three ballheads.

Behind the tank is a radio mounted compartment. Forward the rear of the faulage are speed brakes, consisting of four doors which open inward. The rear of the faulage has an opening on the sides through which the variable speeder stabilizer is fitted.

At the tail post the faulage ends with a ballhead, to which the faulage and is fitted.

Below and behind the wing box, the faulage has a stabilizer strut bearing to provide resistance from the rearward.

To improve the thermal insulation between the faulage and the faulage structure, a hollow space hot loose felt, reinforced by means of air flow obtained by a fan on scoop.

The variable incidence stabilizer in control unit, by hydraulic servo control unit, is means of a lever at the left of the pilot's seat. This lever is connected by means of a rigid coupling,

which can be disconnected, to the elevator control.

Flap a flap is created in which the stabilizer may be trimmed by releasing it from the elevator control.

In case of failure of the hydraulic system, the stabilizer must be disconnected in order to leave the pilot free to operate the elevator manually.

## Landing Gear

The landing gear is of the simple, retractable type and is hydraulically actuated. Both the nose gear and the two main gears have liquid spring type struts, with landing link.

The two main wheels have partial controlled hydraulic brakes.

Retraction of the nose gear is forward with the gear boosted in a well as the faulage nose.

The main landing gear is retracted behind the wing box and is housed in the faulage. In the extended position, the main landing gear doors remain closed, thus improving the aerodynamic performance of the aircraft in the take-off position.

Engine is tube mounted on the faulage forward ballhead. The engine suspension includes two main post situated close to the engine's center of gravity and two rear fasteners which allow some axial displacement.

The engine is inclined upward, the rear end is fitted into an elbow which houses the tail pipe at the opposite end. The elbow is supported by a couple

of links which allow its axial displacement and angular arm variation. The tailpipe is supported by the elbow at the front and by the external frame at the rear. The second coupling is of the link type and allows axial and lateral displacement.

Aft of the exhaust pipe, the faulage structure is protected by the double wall air circulation and the stainless steel exhausts.

The engine is not connected directly to the faulage nose shell in which it is installed.

## Nose Half Shell

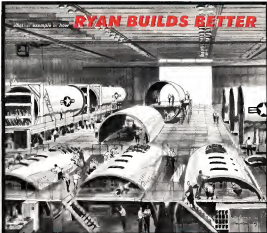
The nose consists of two half shells which are joined according to the horizontal parting line at the front end with a slight misalignment at the rear.

The upper half shell is hinged to the nose ballhead of the faulage and connected by pins with the lower half shell at the front ring, another set of linkage completes the connection of the two parts. The lower half shell is attached to the nose ballhead in seven of four desirable fittings.

To allow frequent inspection of the engine, the two parts of the nose gear are disconnected and the upper half shell is lifted like a normal automobile hood. In case of inspection and work requiring greater freedom of movement the nose covering may be axially disassembled, leaving the engine completely exposed.

With the nose cover, the nose wheel

## RYAN BUILDS BETTER



## RYAN BUILDS GIANT SECTIONS FOR JET TANKER-TRANSPORTS

The largest aircraft structure ever subassembled for quantity production is being volume produced by Ryan. Giant oval and all fuselage sections for the Air Force KC-135—the nation's first jet tanker-transport—are steadily flowing from Ryan to Boeing's Seattle-Benton plant. Disposable sections are also being built by Ryan for the Boeing Boeing 707, America's first commercial jet aircraft.

Ryan's ability to meet the myriad of new and varying requirements of this huge project and produce and deliver as schedule, is the result of Ryan's "lean line" and drive based on many years' experience. This includes 7 years of volume production

of similar bearing sections for the performance of the KC-120. Boeing's propeller-driven KC-97 Stratofreighter "to meet the new challenge. Ryan specialists developed a whole repertoire of new techniques, including the most extensive and advanced use of prototype welding ever applied to large airplane construction.

Ryan's unique capabilities—precise planning, close coordination with customer and quality production—are important factors contributing toward the ideal of maximum utilization of the nation's most efficient industrial capacity for defense production.

**BUILDING AVIATION PROGRESS SINCE 1922**  
Aircraft • Power Plants • Avionics  
Ryan Aeronautical Company, San Diego, Calif.



which is fitted to it also is secured. In this case, the third point of support of the section is provided by special jigs for this purpose.

The tank system is pressurized at 110 p.s.i.c.w.

Fuel is stored in four fueling tanks giving a total fuel capacity of 512 gal., sufficient for accomplishing the ground attack mission. For the extra caution against the utilization of only two tanks it is known, with a fuel and stability of 178 gal.

### Armament

The two 30 mm Hispano-Suiza guns are mounted on the fuselage ahead of the center of gravity to avoid stability problems during firing.

The guns are lowered, by means of a manual unit, in the main fuselage bulkhead. Recoil is directly discharged on the wing box by means of two steel

### Sagittaria Performance

Length	38 ft 6 in.
Span	24 ft
Wing Area	157 sq ft
Empty weight	4,950 lb
Total fuel capacity	512 gal
Maximum instantaneous capacity (banking gear)	2 x 136 rounds
Maximum wing moment load	1,470 lb
Total Weight	
Normal, in intercept	
Fuel 2,265 lb—200 rounds	7,200 lb
Maximum, in intercept	
Fuel 2,265 lb—150 rounds	8,500 lb
Maximum, in tactical attack phase	9,750 lb

### Performance (normal load)

Takeoff speed on 30 ft altitude	3,120 ft.
Climb to 20,000 ft	3 min.
Climb to 30,000 ft	6 min 30 sec.
Service ceiling (W, = 1 motor)	45,000 ft.
Sea level climbing speed, 3,000 ft/m.	550 mph.

### Range (normal fuel load)

Range, including climb to 20,000 ft	475 mi.
Minimum endurance	1 hr.
20,000 ft.	1 hr. 10 min.
Resulted range after climb to 20,000 ft and 10 min.	
Full throttle flight (normal) 250 mi.	
Range (normal fuel)	
Range including climb to 20,000 ft.	615 mi.
Maximum endurance at 20,000 ft.	
2 hr. 20 min.	
Resulted range after climb to 20,000 ft and 30 min. full throttle flight (normal)	715 mi.

### Attack Mission.

Takeoff over 90 ft. altitude	4,650 ft.
Sea level maximum speed	600 mph.

## ALL AMERICAN INGENUITY



Close Weight Aircraft

## A tight squeeze for safety

It is impossible to squeeze water but All American has developed a water "squeezing" principle to increase the safety of commercial jet transportation.

Absorbing energy by drawing a piston through a water-filled pipe has resulted in arresting gear now in service with the Armed Forces.

Now All American's engineers have carried the water "squeezing" principle one step further and have developed an emergency overrun barrier for commercial airports. Stopping jet transporters in a few hundred feet in case of take-off or reverse than failure, this new concept prevents loss of million-dollar aircraft and possible injury to passengers and crew.

All American's water "squeezing" principle makes the barrier safe, economical and easy to operate.

Engineers interested in carrying out "squeezing" ideas, like "squeezing" water, contact Wm. J. Jones, Personnel Manager, All American Engineering Company, Box USS 2665, DePaul Airport, Wilmington 5, Delaware.



WILMINGTON 5, DELAWARE • BRIDGEWATER

*All American Engineering Company*

BUCKET AIRPORT • WILMINGTON, DELAWARE



## New Vickers Airborne Electrical Power Package

... Saves Weight  
and Space

Utilizes the Hydraulic System for More Efficient Production of AC Power

This new isolated electrical power package provides cleanly regulated AC power with minimum weight and volume, while drawing its power from a hydraulic system. In new design or when adding electronic equipment to aircraft design in which the electrical system is already loaded to capacity, this versatile package provides the needed AC power from flow available in the hydraulic system. This generally is permissible without system change as the full flow is seldom demanded except for a few seconds under rare circumstances. Even in such cases, full flow can be guaranteed to these hydraulic functions through the use of a single primary valve which steers the AC power package momentarily.

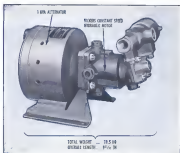
### Less Weight and More Efficient

Important weight savings are achieved through the use of this package instead of an inverter which may also require an inductor or a DC generator and line capacitor. In one instance, the 715 lb. AC package replaced a 36 lb. inverter for co-pilot instrumentation. As a result, the average weight of the package has 52% more efficiency while that of the inverter was 25-47%.

Extreme altitude operation is no problem as the Vickers isolated electrical power package contains no helium or other altitude-sensitive components.

### Features of AC Generator

The permanent magnet type AC generator has compact size and reliability. It requires no bulky voltage regulator ... is inherently smaller and lighter than conventional generators due to the elimination of the exciter and slip rings. It also has higher overall efficiency resulting from elimination of all excitation losses. Additional advantages are that the permanent magnet is unaffected by secondary rotor current, as separation of field and stator without keeper, or by temperature cycling. It is also not susceptible to aging or shock. This unit is 120/285 volt, three phase, wye connected with 400 cps at 8000 rpm. It is capable of continuous duty under continuous of 7-55,000 feet altitude



and ambient temperatures from -55 F to 250 F.

### Hydraulic Motor Drive

The generator is directly driven by a Vickers Constant Speed Hydraulic Motor having load strike and an integral flow control valve that maintains an 8000 1/2 rpm speed ranging within  $\pm 3.5\%$ , regardless of the load (as long as valve train pressure is greater than load requirement). For the unit shown above, maximum operating pressure is 3000 psi while rated output of 1 lpm psi special configuration will maintain 400 cfm frequency within  $\pm 0.1\%$ , regardless of load. This motor has a very high torque-power-weight ratio and its overall efficiency exceeds 92%. It is a time-proven design capable of many thousands of hours of continuous service without vibration.

### Many Uses and Sites

The applications for this isolated power source are numerous. For single-engine aircraft, as well as the multi-engine aircraft, it provides dual reliability. The package has been used to supply centralized frequency AC power to instrumentation when the only source of power in the airplane is a ram air turbine driven pump. The efficiency of this arrangement minimizes the size and weight of the ram air turbine assembly to provide emergency hydraulic and electric power.

Now available in the sizes listed below, larger packages can also be supplied from existing components. Vickers is prepared to develop the package best suited to specific needs. For further information, get in touch with your nearest Vickers Aircraft Application Engineer.

Vickers Airborne Electrical Power Packages	
Line output weight, pounds	Weight, pounds
0.5	1.0
1.0	16.0
1.5	15.0
2.0	15
2.5	17
3.0	30

Larger capacities with minimum weight are available.

## VICKERS INCORPORATED

Division of WESTINGHOUSE CORPORATION  
 Aero-Hydraulic Division  
 Engineering Office with Technical Staff  
 Engineering Center P. O. Box 2001  
 Bristol Rd., Malvern, Pennsylvania  
 General Sales and Service Offices: Birmingham, Birmingham, Tenn. Branch, P. O. Box 460, Nashville, Tenn. Branch, P. O. Box 103, Dallas, Tex. Branch, P. O. Box 103, Dallas, Tex. Branch, P. O. Box 103, Dallas, Tex. Branch, P. O. Box 103, Dallas, Tex. Branch, P. O. Box 103, Dallas, Tex.  
 TELEPHONE: BRISTOL 3-5200 • FLEXIFLYTE, INC. TEL. BRISTOL 3-5200  
 CIRCLE 32 ON READER SERVICE CARD  
 VICKERS IS A MEMBER OF THE WESTINGHOUSE GROUP OF COMPANIES  
 Englewood and Buckleys of Oil Refinery Equipment Book 31271-11

beam fitted to the foot wing spar, close to the foot wing fitting.

Annexation loads provide 170 loads per sq. ft.

Wing auxiliary structure (stitch panels) includes the following:  
 • Two 500 lb. bulkheads.  
 • Two 715 lb. sparline bulkheads.  
 • Two gussets weighing 500 lb. each, on sparline.

• Twelve 1 in. skins.  
 The bulkheads, sparline bulkheads, or the gussets are bolted from fixed cross beams which can be located under the wing, in line with the boundary layer fence.

The gun nacelles are designed to include the gun and related accessories box. The location of the tank and case is left free and there is no possibility of interference with the fuel system, because of their forward position.

If 30 mm. Adair guns are used, the installation has maximum 160 rounds. The ordnance is mounted in four groups of three, two from each outer wing in the area between the leading gear sets of sections and the wing fences.

## Grounding Lifted for RAN Sea Venoms

Melbourne—Great Off Sea Venoms control of the Royal Australian Navy have been allowed to resume flying, but this is taking place on a greatly restricted scale.

The grounded aircraft are not allowed to be launched by catapult and their maintenance is considerably reduced. Details of modifications are still unknown.

Royal Australian Navy is trying to obtain the unfavourable publicity and is keeping the matter in secret as possible to avoid criticism of having selected an unsuitable plane.

## Beverly Air Drops 29,000 Lb. Steel Load

London—Hullburn Beverly four engine military transport released 29,800 lb of supplies by parachute. The plane was flying 136 mph at 1,500 ft when an extraction parachute dragged the load from the tailgate. After the extraction chute fell away, eight parachutes, each 6 ft in diameter opened. These chutes were allowed to automatically set the load but the plane.

The drop, at Midlet Waghlan, East Yorkshire, lasted 33 seconds. Enclosed C 113 dropped a 27,000 lb. single load of iron by extractor and weather load of 35 A-22 containers, weighing a total of 29,000 lb. It separates parachute in tests at 10 Contra Cold (AW Aug 5, 1955, p. 49).

Modern aircraft are ready for  
any extreme of temperature  
... thanks to



You can count on Flexiflyte® flexible ducting to give top performance in demountable temperatures or at temperatures of 150° F below zero.

Flexiflyte tubing engineers have, through the years, worked closely with designers of military and civilian aircraft in developing ducting for aircraft de-icing equipment, heating, ventilating, cooling and ground support servicing. Our laboratories are capable of developing ducting and tubing for any application. Recently we have opened West Coast laboratories

to provide faster and better service to the aircraft industry.

Send today—Dept. 205—for more information about Flexiflyte, the amazingly versatile ducting. If you have problems involving the maintenance of air or heat, our experienced engineers are ready to provide you with application assistance.

Represented exclusively by  
 Aero Engineering Co., and  
 Alsupco Co., and by Annco-  
 Industrial Industries in Seattle,  
 Washington.

**Flexible Tubing**  
 CORPORATION  
 GUILFORD, CONNECTICUT • LOS ANGELES 44, CALIFORNIA



**JT-37** engine installed by Stewart-Davis Jet-Pak jet test cell with both propeller sections.



**TRANS WORLD** Airlines uses a single engine for its C-82 maintenance plans.

## Turbojets Aid C-82 Performance

Boards C-82 Packet propulsion and engine plans, limited essentially by one-engine performance, may be making it possible through use of turbines at engine.

Trans World Airlines credits its operating a C-82 with its own modification—a Packard 146 jet atop its fuselage and a more powerful pair of piston engines. Another modification in the line of its development in Stewart Davis, Inc., is being introduced in Mexico and production is expected to begin soon in that country.

The TWA Packet was re-engineered at Gils Field, Paso del Rio, as a "living maintenance base" in the airline. The plane, based at Gils on a 5400 ft. strip, will be used to fly TWA cargo to any point within 1,600 mi. of Paso. The carrier's success maintenance program performed the modification, including addition of the 1,600 ft. strip jet and installation of Pratt and Whitney R2800C33 engines.

Special engine handling equipment with hoists and stands is being installed at TWA's packet, which also will carry other equipment whose weight at the airline's stations is the less. TWA says the plane can be loaded

and in the air within 45 min. in entry stages at other times to keep the airline's passenger operation moving smoothly.

Stewart-Davis, of Garden, Calif., bills its modification the Jet-Packet and plans to offer two kits, providing for one or two of the turbine power plants. Engines are "Turbojet 5000," described as a modified version of the Westinghouse J487K (10) which powered the McDonnell F1H fighter.

According to Stewart Davis, three to six engines for the two jet installations was considered easy on each side of the nose of the high-wing airplane, one at each wingtip, and the fuselage chosen, both atop the fuselage.

At start level, the company decided, passengers would leave seats and get into the jet intake during takeoff. Weight jets were approved as completely installed and operation, and for ease time of both engines on either side would permit control problems necessitating exiting the other jet.

Test flights of the Jet-Packet, Stewart-Davis reports, have shown that a C-82 equipped with the jets and loaded to 24,000 lb will perform with a wide margin of safety during engine out conditions where a standard C-82



## FIVE IMMEDIATE OPENINGS FOR ENGINEERS

**Aerodynamics.** For responsible assignments in airplane or missile design, particularly for analysis of loads and flying qualities for slow airplanes. Analytical work in hyper sonic aerodynamics or mathematical analysis of a variety of aerodynamic problems.

**Wind Tunnel (Instrumentation).** For responsible work with special instrumentation for the 4-foot high speed wind tunnel and wind tunnel models. Degree and at least 3 years related experience.

**Automatic Flight Control Systems (Aerodynamics).** To conceive, synthesize and analyze autopilot and automatic stabilization systems. Requires background in aerodynamic stability and control, autopilot application and use of analog and digital computers. Degree and 5 or more years experience.

**Propulsion.** Heat transfer, duct design, loads, performance.

**Structures/Design.** Stress analysis, materials, weight control, flutter and vibration.

**For advantage for a personal interview, or for a prompt report on them or other career concepts, return coupon to:**

Mr. C. A. Budo  
Research Engineering Personnel  
Chas. Vought Aircraft, Dept. A-8  
Dallas, Texas

I am interested in a detailed report ( )  
or general interview ( )

On typing list: \_\_\_\_\_  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City and State: \_\_\_\_\_



A  
**Vought  
Vignette**  
NO. 4 IN A NEW SERIES



## The Aerodynamicist Who Test-Hopped Equations

There'd never been a fighter that would hold at more than 1,800 mph one minute and land on a carrier the next. And as a result there was usually less advance interest in the flying qualities of the airplane proposed by Chance Vought.

Jim Madson was more than serious. As an aerodynamic design specialist, he would help develop the Crusader's handling qualities. His job began with wind tunnel tests.

As converted tunnel information into a graphic picture of static and dynamic forces affecting Crusader stability, he used analog computers and systems of wires to produce the load-up of forces during maneuvers. Flight maneuvers, limits, and required rates of structural stresses were determined and related to stress mechanism and Principal Design groups. So too the Crusader's steadiness and power assisted packages began to take shape.

Jim's part in the project would have ended right there. But Vought's overall system simulator helped him proceed to some thoroughgoing conclusions.

It duplicated the complete real system and all mechanisms that would control the speedy new fighter. It the simulator's cockpit, high above the Structure

Lab floor, his pre-recorded control responses that test pilots later would experience. Angles responses to limit rudder kicks and aileron movements were recorded on analog computers. Any instability of the control system to produce the aircraft during flight was easier to spot and with test and design engineers on hand — easier to correct.

"It was like a big rehearsal — only better," says Jim of the simulator.

"I gave me a chance to work with the whole system."

"And actually watching control responses to the controls gave me a feeling for how test they happen."

Another thing that moved Jim was Crusader development. Vought's simulator and other facilities detected problems before they compounded. The fighter needed operational readiness in record time.

Research, design and test facilities at Chance Vought allow the engineer to do a thorough job in advanced problem areas... ensure high reliability on Vought-developed weapon systems.



CHANCE **VOUGHT AIRCRAFT**

# PROVEN PERFORMANCE

in a hermetically sealed

## ROTARY MOTION SWITCH

MAXIMUM 125 VOLT AC  
MAXIMUM 10 AMP @ 25° C  
MAXIMUM 10 AMP @ 55° C  
MAXIMUM 5 AMP @ 75° C  
MAXIMUM 2 AMP @ 100° C



ROTARY SWITCH  
INDICATING VIEW

The many switching jobs done best by rotary-motion (rot) switches can now be done even better! Electro-Snap's new shaft seal gives you positive hermetic sealing, simplifies mounting, saves weight and space, and provides a full 50,000 cycle lifetime life.

Elimination of external contacts, cams, links, and other gear to transmit rotary to linear motion, but it often does so parallel use of hermetically sealed, low-type reinforced stainless steel, space conserving, and its need for tedious adjustment. This simplicity gives you greater freedom in locating interlock and locking switches on rotary mechanisms, allows positive linkage attachment.

Use, altitude, rate, or sensitive mechanisms control after this Electro-Snap switch installed in a dry, inert gas. The steel case protects against shock, prevents loss of the hermetic seal—also permits light drop-off on remaining bolts without "springing" the seal.

GET FULL ELECTRICAL AND MECHANICAL DATA IMMEDIATELY—WRITE FOR DATA SHEET E15-M-4

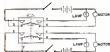


**ELECTRO-SNAP**  
SWITCH & MFG. CO.  
430 W. Lake St., Chicago 24, Ill.

- A seal — not a packing — bonds shaft to case.
- Leakage rate 150 (less 1 micron per sq. in. per hour) full rating up to 75,000 lb. altitude.
- No-clip splined shaft — adjustable or fixed retaining arm.
- Points 120° relay travel on a maximum of 20,000 cycles.
- Long unswitched intervals need no fine adjustment, permits greater flexibility in linkage action.
- Tough, dimensioned case. Split two-bolt mounting.



TYPICAL CIRCUIT



- 1-3—Remote lamp indicates when arm is fully into seal.
- 3-4—Motor driving linkage operates clockwise 120°.
- 5-6—Switch stopped motor at predetermined position.
- 7-8—Remote lamp indicates arm at full travel position.

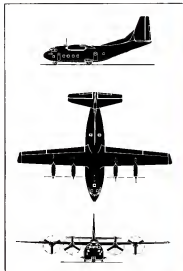
would immediately begin to lose 20 to 300 ft. a minute. Drag of the jet fuel is used to cut only 5 mph less than the plane's cruising speed with its piston engines.

Operating procedure with the jet-fuel cells for firing up the turbines or main during final check and running them at MTO power during takeoff and climbout. If a piston engine fails during takeoff, the pilot is advised to idles its power.

Steward-Dave chose the jet modification will cut 25% of takeoff distance needed to clear a 20 ft. obstacle at 14,000 lb. weight (two pilot). Rate cost \$11,000 with two engines at \$55,000 each, not fueljet.

They can be installed in 100 man-hours with simple tools, the company told Armstrong Watts.

Production kits will be made under contract by Service Aeronautique de Mexico.



### Fairchild Turboprop Transport

Five turboprop engine transport to C-119 and C-115 is planned by Fairchild Engine and Airplane Co. Prototype of the engine, designated the "Turbo-Union," will use 1,000-hp 1500 rpm. Boundary layer control is expected to reduce overall takeoff distance from 2,200 ft. to 1,700 ft. Airplane will gross 75,000 lb., no fueljet, carry 32,141 lb. payload on dual track (AW April 29, p. 27).



radars

fire-control

mine laying

countermeasures

missile launching

navigation

Over 20 years' experience in development and mass production of radars and approved by military and commercial air forces and navies

THE NO. 1 **MAXSON** COMPANY  
17700th Avenue, Long Beach, California

Ask for  
our latest  
fact files  
brochure

Illustration: Courtesy of Lockheed Personnel  
Wingspan for comparison

## THE VERY FINEST VINYL INSULATION SLEEVING FOR EVERY NEED!

Whatever your requirements in vinyl insulation sleeving, tapes or lining coats, Resinite has a material that will do the job superbly well. In intensive research, careful compounding, meticulous manufacturing and rigid inspection have made Resinite the logical supplier of aircraft engine vinyl insulation sleeving to the aircraft and electronics industries. Safe by leading die trialsmen throughout the United States.

### LOW TEMPERATURE

**ML-1704402** This USAR specification is met and exceeded by Resinite EP 33. For extreme low temperature use (-30°F) flame and fungus resistant. Approved in all these size ranges.

### MULTI-PURPOSE

**ML-14232** All requirements for Grades a and b of this multi-purpose specification — wide temperature range, high dielectric strength, corrosion, fungus and flame resistance — are met by Resinite EP 65A, Grade c (high temperature) is met by Resinite Wt Heat 105A. Where fungus

and flame resistance are not required, Resinite EP 2 is suitable.

### HIGH TEMPERATURE

**U. S. 105°/2 GRADE \*** For continuous operation at 205°C with good resistance to oils and chemicals. Met by Resinite Wt Heat 105.

Resinite Super Heat 125° is far superior to normal grades of 135°C sleeving. Exceptional resistance to oil through, oil, varnish, pitch. High dielectric strength. Operating range is from -42°C to 125°C.

\*Approved for use in U. S. listed devices.

### ABRASION AND CUT-THROUGH RESISTANCE

**ASTM D 372-54T NEMA V51-1958 ML-13186/A** These specifications are exceeded by Resinite Vinyl-Glass, a specially woven and treated fibreglass sleeving covered with a superior grade of vinyl dielectric strength to 8000 volts rms,

Call your Resinite distributor or write for samples and performance data.

# Resinite

Resinite Division  
**THE BORDEN COMPANY**  
Chemical Division  
Box 1305, Santa Barbara, Calif.

## PRODUCTION



FINAL ASSEMBLY line for Allison T15 engines in Southwest American engine overhaul shop at Dallas, Texas.

## Southwest Enters Jet Overhaul Race

By Craig Lewis

Dallas-Southwest Aerospace Co. is using its experience as an overhauler of military turbine engines to support a bid to overhaul jet engines for the Navy.

After two to three years of overhaul, jet engines are replaced at a rate of one per day at the primary logistic for SAC's drive. Seek large volume contracts in Eastern Air Lines, Pan American World Airways and American Airlines probably, not spend their costs over enough engines to bring

prices down to Southwest's level. Such efforts are being demonstrated on domestic carriers, and all U. S. airlines have been contacted. While SAC has not contacted foreign airlines, the company feels that a foreign carrier with low overhead volume could pay the price of shipping its engines to Dallas and still see a profit.

By mid-1959 when the system starts overhauling jets, SAC will have overhauled more than 6,000 turbine engines for the Navy and Air Force.

SAC began overhauling piston en-

gines for the military in World War II and got into the jet overhaul business early in 1953 with a \$3 million contract to overhaul 1,200 Allison J33 engines (AVW Div. 4, p. 147). After five months and \$1.5 million were spent in proving out engine and equipment for the job, Southwest Aerospace received its first turbine overhaul job.

In November, 1956, the company secured a Navy contract for T15 overhaul, and T15 production will shortly exceed a rate of 70 engines a day. SAC has the design and modification tool-



SAC WILDER works on T15 ring and tube assembly (left), Augmentor tube (right) engine exhaust heat jet engine into test cell.



## NEW...CHR fuel resistant silicone rubber COATED FABRICS

Jet fuel, hydraulic and synthetic oil resistance; —85°F to 400°F range.

CHR has added "L-8-12" coated glass, "Dacron" and nylon fabrics to their line of COATED FABRIC Coated Fabrics.

The new "L-8-12" coated fabrics provide vapor, splash and immersion resistance to fuels, hydraulic and synthetic oils over a temperature range of —85°F to 400°F, depending upon base fabric. Supplied in continuous lengths, CHR's "L-8-12" coated fabrics provide the most economical use of the new, high performance elastomer.

Many other silicone rubber coated glass, "Dacron," Orlon and Nylon fabrics (85°F to 400°F applications other than fuel resistance) are available from stock or can be made to order. We will also custom design fabrics to meet specific requirements.

CHR supplies both coated fabrics and finished assemblies made from these fabrics such as venturi boots, silicone curtains, radomes, fuel cells, conveyor belts, window covers, fuel and fire barriers, and gaskets.

Write for bulletin describing both "L-8-12" and regular silicone rubber coated fabrics.

"See-Through" and fuel resistant fabrics.

**CHR** 1000 N. GARDNER PARKWAY  
MILWAUKEE, WISCONSIN 53217  
WALTER ARONSON, INC.  
1000 N. GARDNER PARKWAY  
MILWAUKEE, WISCONSIN 53217

**CHR**  
THE CONNECTICUT  
HARD RUBBER CO.  
407 WEST STREET • NEW HAVEN 2 • CT 06510

on the J37 for Ford, but the J13 is the only jet the company has produced thus far.

Civilian work on both piston and jet engines is done at SAC's 114,000 sq ft shop at Love Field. With its present volume of business from military and civil customers, Southwest Aerospace doesn't see any need to expand facilities further to handle airline turbo-prop engines. Production volume would be increased by increasing shifts.

Under present contracts SAC produces the J13 A24A for the T2V2, the J13 A31 for the F-80 and T-33, J13 A17 for the F74 and the J13 A17 for the Martin Marietta Company also services Fiat & Whitley B26C, B2000, B1200 and B950, Wright R1320 and Lycoming and Continental engines.

### Isolated Test Cells

Piston engines are tested in cells built into the Love Field engine facility.

The jet engines are tested at an isolated zone of test cells built near Ft. Worth's Airco Center Field.

The engine tool provides a major part of Southwest Aerospace's annual business. The company's sales will exceed \$4 million in the year ending May 31, and profits are expected to improve that year after a poor showing last year due to tooling and training costs.

New contracting at 196 stations, Southeast Aerospace is at the middle of an expansion program that will raise its work force to 750 employees by fall and will provide 500,000 sq ft of space by early 1958.

Last year, military sales were 24% of total business and about a third of the service division's 70% share of total



J13 COMPRESSOR rotor goes through ultra-sonic inspection with Sperry Radioscopes.

volume. Sales Division does about 10% of SAC's annual business.

Southwest Aerospace's recent expansion program was triggered by Dallas' general development program for Love Field. Since the new passenger terminal is under construction on the site of SAC's old service base, the company borrowed \$1.5 million from the city's airport bond fund on a 15 year term to help finance a \$2 million base across the field from the old base. The engine overhaul facility isn't affected by the move.

### Base Expansion

The new base has 11 acres of empty space and an 80-c-400 ft storage barge. Work on two service hangars and a push terminal building is scheduled for completion in August. Construction of another two hangars is scheduled for completion early in 1958, giving South-



G. D. Scott (center), Flight Controls Department head, discusses a model control system with Group Engineer R. A. Fry (right) and F. C. Hudson, missile computers research specialist.

## FLIGHT CONTROLS THEORY

The transition from theory to reliable components is one of the most difficult phases of flight controls evaluation. At Lockheed Missile Systems Division, engineers and scientists are performing advanced work on a number of theoretical approaches that offer important practical solutions.

Two of the areas are:

- Utilization of fuel-back design techniques for optimizing complex dynamic systems.
- System verification by analog computer simulation.

Significant developments in these and related areas have created new positions at both Sunnyvale and Van Nuys engineering centers. The complex nature of the assignments requires both flight controls experience and the ability to increase individual initiative. Inquiries are invited.

*Lockheed* MISSILE SYSTEMS DIVISION  
research and engineering staff  
LOCKHEED AIRCRAFT CORPORATION

FALD AERO • SUNNYVALE • VAN NUYS • CALIFORNIA



OVERSIZED engine is loaded into an Air Force C-119 for expedited delivery.

# U.S. NAVY expands its fleet of cargo-passenger GRUMMAN TF-1 ship-to-shore "TRADERS"



## powered by **CYCLONE 9** engines

The U. S. Navy will soon have more Grumman TF-1 "Trader" cargo-passenger planes. These are the aircraft that ferry passengers and cargo between carrier and shore. An initial fleet of these planes has been thoroughly proven in two years of service for the Navy's Fleet Logistic Air Wings. Their short take-off, long range, and high dependability—made possible by Curtiss-Wright Cyclone 9 engines—have made the twin-engine "Traders" indispensable in the rugged all-weather job of carrier resupply.

The Curtiss-Wright Cyclone 9 — one of the world's best-proven engines — is the powerful answer to many special problems and sea-requirements in modern aircraft, both military and civil. Powering transports, patrol and recon aircraft, sub-busters, trainers and helicopters today, the Cyclone 9 has the longest service background of any aircraft engine type. It is another example of Curtiss-Wright leadership in power for the present and future needs of military and civil aviation.

### YOUR MEN BECOME A NAVAL AVIATOR



Apply at any Naval Air or Recruiting Station



WRIGHT AERONAUTICAL DIVISION  
**CURTISS-WRIGHT**  
22170 110th • WOODBRIDGE, N. J.

*World's Finest Aircraft Engines*



### Swiss Fly P.16 Fighters

Second and third prototypes of Swiss-designed and built P.16 fighters, shown in test flight, indicate earlier completion of final model (below) than had been expected. Armstrong Siddeley Sapphire power-plant fighter in conventional design with large flap for operating from short runways (below) (NAM July 6, 1948, p. 31). First prototype was developed as an aircraft; Swiss cancelled order for French fighters to build own fighter.

and Armstrong in 100 x 158 ft. service building.

With an investment of \$1.1 million in its engine facilities and \$112,000 in its site installation, the new service base will give SAC a 51.2F million installation.

The company also has a \$2 million program calling for construction of more hangar space and a distributor sales and general office building within the next five years.

SAC's Service Division is a dealer for Trucon and Magellan products, and the company provides flow solutions of aqua and JP-4. Southwest Aircraft Co. has a contract to install transient sub-

mers aircraft, both gasoline and jet. Last year, the company bought an additional gallon of fuel for sale and for its own use in testing program. The new service base has underground storage tanks for 218,000 gallons of fuel.

SAC's sales operations started during World War II, and a separate Sales Division was established at the end of the war. After some disappointments when the private flying boom failed to materialize as the years after the war, Southwest Aircraft has now built its distributive sales volume to a rate of \$2.5 million a year, including sales to 17 airlines.

The company is currently distribute

### MANUAL CONTROL VALVE



By  
**M. C. MFG. CO.**

The MC 1888 Valve is  
**MC 1888 VALVE — AIR  
CONTROL, THREE PORT**  
Solving the following aircraft  
problems:

- RAISE** Air in 10 seconds
- PERFORMANCE RANGE** 0 to 3000 psi
- TEMPERATURE RANGE** — 81°F to +235 F
- WOGN FACTOR** 5 to 27
- PORT CONNECTIONS** 1/2" NPT, 1/2" NPT, 1/2" NPT
- INTERNAL LEAKAGE** 3 cc/hr. min. with 3000 psi air pressure port
- EXTERNAL LEAKAGE** 2 cc/hr.
- WEIGHT** 2 lbs.
- MILITARY SPECIFICATION** Applies to all paragraphs of MIL-P-2219 and MIL-P-2224

### Hydraulic and Pneumatic Components for the Aircraft Industry

VALVES OF ALL TYPES: Relief, Solenoid, Manual Control, Shuttle, Shuttle + Valve, Cam, etc. — Plus a variety of Pressure Reducing, Backcheck and Special

AERO AIR COMPRESSORS — Fuel Pumps, Detectors



**M.C. MANUFACTURING CO.**  
118 BILKOWITZ BLVD.  
LAKA ELMON, MICHIGAN

War Case Office 716 Wiggins Bldg.  
Dearborn, Mich.

Representatives:  
S & O ENGINEERING CO.  
P.O. Box 2107, Wichita, Kansas

L. POLANSKI  
1508 17th, N.E. Seattle 11 Wash.  
P. C. BERRY  
1322 Duane, Erie, Pa. 16540



**PACKARD ELECTRIC** / *Make wiring jobs easy*



**AIRCRAFT CABLE** / *with cable you can trust!*

Just as Packard Electric cable—standard of the industry! Aircraft manufacturers use it on the new planes and you can see it, too, when wiring engines, lights, radios and any other part or accessory requiring electricity.

You'll find Packard Electric cable is easy to strip and braid. You can run it through small holes without aging assistance. You can flex it, heat it, cool it—use it under most every conceivable condition of temperature and altitude. And though small in

diameter, then for class its strength resistance is unsurpassed.

Fast by foot, Packard Electric cable greatly exceeds all the established measurements of uniformity and quality not by military and airlines manufacturers' specifications. In the replacement market it's sold only by reliable aircraft parts distributors who stand ready to give you helpful suggestions and make fast deliveries when you need them.

Whether you're developing a refined new idea in aircraft modification, or

simply doing routine rewiring, you're an expert when you use Packard Electric cable. Ask for it by name. It's quickly available in any type, size or color. Packard Electric aircraft cable is sold by leading distributors everywhere.

**Packard Electric**  
Worcester, Mass.

"Laird White" Division of General Motors

### Turboprop RC-121, WV-2

Laird has patented a fast proposal for the military for a successor to its RC-121 and WV-2 only-wiring cable plants.

Known as company project CL 157 (AW Dec. 17, p. 25), the result will be an extension of present aircraft construction, that it will have Allison T40 turboprop engines mounted on H40A Johnson-Stouffer wing.

Additional modifications include incorporation of the new sensor radars atop the aircraft which houses a new radar antenna, and generates some lifting surface on itself.

One test bed with the new design has been flying in some tests, under the designation WV-2E.

Negotiations for sale of the airplane are being held with both Air Force and Navy.

for General Motors' AC Spark Plug Div., Delco-Remy Div. and Packard Electric Div., B. F. Goodrich Co., Armstrong Corp., Gledhill Co., Gould National Electronics, Green Mountain Insulating Co., Jorgensen Corp., Locomotion, MacWalter Cable Co., Ray-Walton's Price Products Div., A. E. Park Co., Willard Batteries, United Aircraft's Hamilton Standard and Pratt & Whitney Divisions and nine divisions of Boeing Aviation Corp.

### Russians Find Thrust Rises With Radiation

Russia says it is experimenting with radioactive nuclei as a means of increasing jet engine thrust.

In reporting on new applications of radiation chemistry discussed at the recent All-Union Scientific Conference on Radioactive Isotopes and Kryptonite in Moscow, Soviet scientist Nikolai Popov stated:

"It has been discovered that quaternary and tertiary combinations of the fuel mixture can be enriched if a strong source of radiation is placed near the combustion zone."

"It is very difficult to achieve integral combustion of the fuel mixture in a jet engine without pulsations and discontinuities. (Designs have installed) a ring made of radioactive material on the engine nozzle. The radioactive ring emits beta-rays and electrons.

Engine thrust has been increased by 10-15%.

University of Michigan scientists are conducting similar experiments, the most successful using radioactive gold (AW April 12, p. 60).

### FASTENER PROBLEM

Designing any of new 15000 type A2000 nut meets all requirements per all military specification. It is made of steel, not brass, is made from a single piece for easy installation with Allen Bolts. It is possible to make units more easily for installation on the job in the field. Requirements range of different materials in an area available in most existing operating conditions.



### Leakproof self-locking fasteners for integral fuel tanks

Aircraft designers have eyed the space-saving possibilities of "Wit Wig" as integral fuel tanks for some time. But... the "wit" section of the wing must be fastened in such a way that highly volatile aviation fuels will not leak under the force of the tank's pressure or seep out along these bolt threads.

ESNA has just developed the first completely patented answer to this problem. The new ESNA type A2000 fastener-nut-bolt cap nut (see diagram) is a self-locking anchor nut with an "O" ring seal at its base. In tests, the nut has withstood a perfect seal against pressures above 30 psi on either side, regardless of structural stress, vibration, or temperature changes. The seal is effective whether the bolt is installed or not. It is not destroyed by repeated bolt installations.

The type A2000 is the lightest nut of its type. 100 nuts weigh only 1.2 pounds. It meets AN-3-S specifications for operation between -50° F. and +250° F. and can be used for extension beyond these limits by varying its component materials such as the "O" ring. It provides .800 inch minimum bearing surface allowing quick assembly in spite of slight misalignment of both holes. The A2000 is 100% and tested prior to shipment. The basic design has been approved by the USAF. Size ranges from 10/32 through sizes 1/4-28, 5/16-24, 3/8-24, and 7/8-20. A gaging fixture strip providing a series of regularly spaced A2000 nuts has also been designed.



The new locking 200 (left) is among the first available equipped with integral wing fuel tanks like those built with the new ESNA type A2000 locknut nut.

### MAIL THE COUPON FOR DESIGN INFORMATION

ESNA  
ESNA  
ESNA

ESNA Drop Mail Department of Supplies  
Dept. 807-100, 3300 Vanhook Road, Union, New Jersey

Please send me the following free literature information:

Details on A2000 nut  
ESNA, SP07 and bolting

Details on A2000 nut  
as gaging fixture on tape

Name \_\_\_\_\_ Title \_\_\_\_\_  
Firm \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

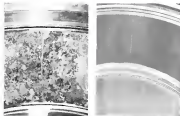


11 famous airlines\* have chosen the superb Boeing 707—to fly you in unbelievable comfort and quiet at 600 miles an hour.



The 707—America's first jet airliner is the brilliant new expression of Boeing's unmatched experience in jet aviation.

**BOEING 707**



217 COMPRESSOR case before (left) and after (right) cleaning by Taurus process.

## Electrolysis Cleans Titanium

Dallas—A new electrolytic process for more efficient cleaning of titanium has been developed by Taurus Aircraft Corp.

Taurus claims it is saving \$5,000 a month with the new process, mainly by cutting the expensive use of titanium parts for military aircraft components laid under various subcontractors.

Process cleans titanium parts by immersing in an electrolytic acid bath. It was created by John J. Duley, supervisor of Taurus's Materials and Finishing Laboratory, and a patent was issued for it earlier this year.

### Cleaning Need

Need for an efficient means of cleaning titanium and its alloys stems from the metal's habit of forming oxide scale when heat is applied during forming operations at stress relieving treatment. The scale dissolves the metal and makes visual inspection of parts susceptible to stress cracks and other imperfections on hidden by the scale and insoluble on by X-ray.

Previously, titanium has been de-

scaled by auto-hydrolytic acid bath, another salt bath or various forms of abrasion. For several reasons, these techniques are cumbersome and costly, and they often result in damage to the metal.

### Ti-Brite

In 1954, Duley developed a new process, now called Ti-Brite, which removes oxide scale by electrolysis. It works on titanium parts of almost any size or shape and removes scale almost instant under heat treatment in the two pressure range of 400 to 1,500°.

In this process, the titanium part is connected to a cathode lead from a direct current source and is immersed in an electrolytic solution. The solution is composed of 1% by volume of a 4% to 70% solution of hydrofluoric acid, 4% of 50-60 deg. Dc sulfuric acid, 22% of 50-60 deg. Dc sulfuric acid, 75 deg water and 1.5 cc. of ferrous sulfate or ammonium sulfate per gal.

A titanium anode is suspended in the electrolyte, and an anodic flow of current is applied for one to three



BRIGHT portion of F-101 tail section has been cleaned. Try the Taurus coating.

IT PAYS TO TAKE A  
"Second Look"

AT THE QUALITY IN THE  
TUBING YOU'RE USING!



1. If "perfection" specifications will improve the performance of your product... "good enough" tubing costs too much regardless of the price!

2. If assembly costs are eating up your profits, TMI tubing means time to save money for you!



The "second" look is typical of cost management and pioneering engineers. They know by experience that "yesterday's" quality standards leave much to be desired. In the small diameter stainless steel and special alloy tubing field, TMI is setting the pace... and saving the best. There's a reason "as good as you should" it stands as one step of two.

**TUBE METHODS INC.**

Highland (Manufacturing) Dept., Pa.

MANUFACTURERS OF STAINLESS STEEL TUBING  
SPECIALISTS IN SMALL DIA. AND SPECIAL ALLOY TUBING  
CALL TOLL FREE 1-800-368-3333





The X-10 test vehicle with remote control in front of the flight station.

## X-10 missile test vehicle returns with good news for electrical engineers

New scientific data allows the Navaho Missile to leapfrog many R & D steps — go direct into advanced stages. Unprecedented success of the supersonic X-10 spells out this significant fact: The Navaho—an intercontinental strategic missile completely automated and constantly guided throughout its supersonic flight by self-contained control systems—is one of America's most advanced missile systems.

This news is important to you—whether you are a 10-year veteran or a recent BSER. Why? Because now you can start at the very top of missile technology—and reap the rewards of being with a years-ahead company.

**40 immediate career opportunities in electronic systems analysis**

In Missile Engineering you'll investigate applications of automation that are literally miles ahead of the field. You'll pursue them in pro flight, test, analysis, checkout, tracking, coordination and flying. You'll work on "in-flight" control and guidance systems to provide that even the environment within the missile must be rigidly controlled.

One of our immediate needs is for electrical engineers—especially those qualified in systems analysis, systems evaluation, component design and ground checkout. No matter what your experience has been it can be needed to us.

For complete details on these—and other engineering openings—please write: Mr. R. J. Cunningham, Engineering Personnel Manager, Dept. 42005, Missile Development Division, 12214 Lakerwood Blvd., Downey, California.

MISSILE DEVELOPMENT DIVISION

**NORTH AMERICAN AVIATION, INC.**



minutes at a DC voltage of from 6 to 16 volts. Current is limited by one to three resistors, then is converted again to an current to flowing in the axial direction.

Treatment is continued with the titanium just as the cathode and scale is loosened or removed. The pH-value usually varies between five and 10 minutes.

The parts are then rinsed in a running water bath. Both the electrolyte and the water bath are room temperature.

Titanco says the process leaves titanium parts with a smooth, natural surface and causes no pitting. Other methods often etched the metal, scratched it or induced pitting.

Elimination of expensive installations and hand labor are cited by Titanco as advantages of the new electrolytic process. With Titanco, Titanco sees one man in handling an operation that formerly required eight and involved a great deal of hand-crafting of parts between operations in acid pits.

Most important saving in the process lies in the reduction of titanium part rejection because of damage to de-sulfurizing. According to the company, the electrolysis does such a delicate job that reworking needs are still visible on the metal after it is dissolved. Most titanium parts cleaned by the new process are for Titanco's work on F-301 jet engines and J57 engine core parts.

After the process was developed in 1954, the company ran a pilot test for about a year. In 1955, a 450 gal tank was installed to handle production work.

A new 1,100 gal tank was installed in January and has handled doubling of all production titanium since then.



### Hot Drawing Extrusion Raises Fatigue Level

Hot drawing manganese steel produces a uniform, 100,000 ultimate tensile strength "forging-proof" extrusion according to the Lehigh Steel Co., Chicago, Ill. The steel is heated in a hot bath to a temperature between 2200° and the critical point and then reduced 30-40% in outside diameter. While the die factors out the crystals, the temperature warms the steel by inside and outside expansion.

**ACCURACY!**

Each month, hundreds of Whittaker gyros are used in the military which is 60% of total. In our nation's defense, accuracy is the greatest of all critical requirements. Whittaker gyros meet these requirements with a typical rate of less than 2%. Whittaker gyros will be placed in place in your systems and facilities at your disposal.

**Whittaker Gyro**

DIVISION OF TELECOMMUNICATIONS CORPORATION  
NEW HAVEN, CONNECTICUT  
WHITTAKER 7-9877

**AIRCRAFT TUBING**

GOVERNMENT SPECIFICATION TUBING IN STOCK

4130 GRADE	4135 GRADE	1025 GRADE
• AMS-3271	• AMS-3272	• MS-15004
• MS-14734	• MS-14735	• AMS-NW-7248

**SERVICE STEEL** • DETROIT, MICHIGAN  
LOS ANGELES, CALIFORNIA

To speed up the "Hustler"

we slowed down the Air!



*How the Honeywell Engine Inlet Diffuser Control adds teeth to Conquest's supersonic B-57 "Hustler"*

As Mach numbers go up, engine thrust can be reduced tremendously by area fractional growth in the positioning of inlet air diffusers. To get maximum thrust, inlet air must be slowed down with minimum drag and maximum pressure recovery.

That's why the B-57 relies upon Honeywell Aero's Engine Inlet Air Diffuser Control, one of which is installed at each engine intake. They automatically control the diffuser configuration to permit maximum engine thrust at all speeds and flight conditions.

Without this Honeywell system the "Hustler" might never reach its maximum supersonic thrust.

Adding Honeywell to the design and production of such advanced mechanical control systems is a history of achievement which includes over one quarter million of the world's most accurate gyroscopes, more flight control systems than any other company has produced, fuel gauges for every type of plane, controls and components for all types of aircraft propulsion systems.

## Honeywell

**H** CONSULTED DESIGN

Engineers! Two hundred and eighty sub-sonic projects are now in progress at Honeywell Aero. You can add one of them from development to ultimate test. Drop your own line of selection, model lists, catalogue request and drawings. You'll get each response and advancement at Honeywell. Your first step today is just the start. If you're a design-developer or producer request, send your resume today to Grant Wood, Technical Director, Honeywell Aero, Dept. 1-A-1, 411 Western Blvd., N.W., Minneapolis 12, Minnesota.



## ENGINEERS...

### ENJOY A SOLID FUTURE WITH CESSNA

Join a company NOW whose planning for retentive expenses is based on a solid balance of military and commercial projects... a balance that provides an interesting diversification of assignments and unestimated opportunities for your advancement. Your family will enjoy the solid future Cessna offers, too! Wichita, third fastest growing city in the States, is a friendly city... ideal for family living, education and recreation. Our plans for your future include assistance in furthering your education and all the usual comprehensive benefits. Why not investigate Cessna today?

Choose your assignments in • Airframe design • Weight control • Power plant installation (jet and reciprocating) • Airframe stress analysis • Jet propulsion • Production layout • Technical illustration • Catalog & Maintenance writing • Engineering checking Offices: Professional Placement Supervisor, Department AW

**Cessna**

CESSNA AIRCRAFT COMPANY • 6500 EAST PAWNEE • WICHITA, KANSAS



**TAPE-PROGRAMMED** cutting machine will be used by Martin Co. in P6M SeaMaster and Minitar missile production. Machine was developed by Bechtel Arctech Corp., will provide fast production application of the parasite.

## Tape Milling to Cut P6M Lead Time

Martin Co.'s new tape-programmed profile milling machine, fast production application of its lead, will cut weeks off lead time in production of P6M SeaMaster outer nose cone fittings, the company reports. It will also be used in Minitar missile production. Machine uses signals from punched tape which guide cutting head over the work.

### Time Saving

Since its close fitting nose will be made possible by using grooves in the form of uncutted description of the engineering drawings and, after suitable translation into the machine's language, programming the machine to mill a finished part. Previous intricate die-cast step of lead made pattern is made from mold left complete to lead to be discarded. The newly-developed machine, which was designed and produced by Bechtel Arctech Co., is said to have the inherent speed and accuracy to mass produce complex parts of repetitive

series frames during robotic emergency crash program. Several benefits are claimed for this type of tape controlled three-dimensional machine. Shapes which are according to engineering standards can be stored for simple call-up as they are needed. Engineering changes can be accomplished in shifting in new tape sections.

At times of abnormal emergency accident manufacturing causes for emergency status can be rapidly reacted by merely routing out duplicate of the master tape.

### Part Capacity

Size of parts which can be handled by the 50 ton machine is said to extend up to whole aircraft wings. As an example of the tape using machine can be selected by the underlying parasite. Bechtel Arctech will monitor case for a jet engine fuel metering system. Five to ten weeks of highly skilled work was reduced to 24 days in an earlier version of the tape controlled process.

## BUCKETS and BLADES for AGT

We design and build:

- Forge Dies
- Trimming Dies
- Investment Molds

We machine to ✓

- Forgings
- Solid Stock
- Investment Castings
- Centrifugal Compressor Wheels

Your certification



**Therm-electric**  
METERS CO., INC.

Ithaca, New York

# 400° F

## new synchro

- 350 hour life at 400°F.
- Unprecedented -65°F to +400°F operating temperature range.
- Unique lubrication method.
- Special alloy for electrical connections.

Type 11-4123-24 is a size 11 torque transmitter synchro with 110V 400 cycle input. Accuracy is  $\pm 1\%$ , full voltage 175 cps, stator output 90 volts and phase shift 6.5°. Impedances are  $Z_{DD} = 315 + j1.660$ ,  $Z_{DQ} = 290 + j770$  and  $Z_{R22} = 520 + j2391$ .

This is another Oster "first." Write for further information today.

Engineers for Advanced Projects  
knowing, and used in designing  
complex circuits and systems. Contact  
Mr. Edson, Director of Research & Development

**John Oster**

MANUFACTURING CO.  
Your Rotating Equipment Specialist

Arlingdale Division  
Riverside, Wisconsin

Other products include actuators, servos, AC drive motors, servo mechanisms assemblies, DC motors, motor-generators, fast response servos, servo torque units, reference and tachometer generators and motor driven blowers and fan assemblies.

**Oster**



PHOTOGRAPH BY JAMES H. HARRIS



## F-100 Rolls For Camera

North American F100D Super Sabre is photographed for the first time following a slow roll. Photography was taken from the tail gun slot of an Air Force B-15 Toronto bomber. The plane was flown by George Mattison, North American chief production pilot. Engineers rate him top 10% in flight.



**BIG or SMALL**  
they all  
**SHINE BEST**  
**SHINE LONGER**  
**SHINE EASIER** with

**NEVR-DULL**  
Aluminum Cleaner and Polish

The original aluminum-  
restorer. Cleans surface, prevents  
oxidation, removes lacquer, restores  
luster, improves finish. Available  
in 4 oz. and 16 oz. cans. **AVAILABLE**  
at dealers. **NEVR-DULL**  
Aluminum Cleaner and Polish. **NEVR-DULL**

Manufactured exclusively by  
**George BASCH Co.**  
177 Route 200, Franklin, N. J., N. J.

Great place to build a career...



HOME OF INTERNATIONAL AIRCRAFT EQUIPMENT DEPT.  
We are interested in your ideas and your work.  
We are interested in your ideas and your work.  
We are interested in your ideas and your work.

Consider Careers for  
**AIRCRAFT EQUIPMENT**

Flight Performance  
Service Administration

Design & Development  
**ENGINEERS**

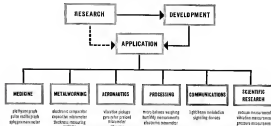
We are Engineers for Most Applications  
(The Field/Shop) Electrical-Mechanical-  
Structural-Transportation or General  
Aeronautics. Some 2500 Opportunities.

Advanced Opportunities in  
Aircraft, Space  
and Defense Equipment

Westinghouse  
Aircraft Equipment Dept.  
P. O. Box 100  
Coraopolis, Pa. 15108



## INSTRUMENTATION



**an idea is the solution to every problem**

Decker Aviation is a company of ideas.

Not long ago, for example, Decker took the idea of an induction transducer and brought the idea to reality... then used it imaginatively to solve pressing problems in a number of far-flung fields.

In medicine, Decker applied the transducer to the improvement of such basic instruments as the polythymograph... giving medical researchers a new markable of sensitivity in their explorations.

For geophysical research, Decker ideas made possible instrumentation that, mounted in the nose of an Aerobee-Hi rocket, measured an altitude of 115 miles, continuously and accurately measured both rain and ambient atmospheric

pressure at speeds in excess of a mile per second.

Apply our new ideas to the micrometer comparator, Decker gave the production line an instrument for measuring an object without physical contact to within a few millionths of an inch.

All the examples listed on this page hardly begin to show the extent of Decker accomplishments. For one problem after another, we have found the idea... developed it into a solution... built prototypes... even manufactured finished instruments.

We would honor an opportunity to evaluate your problems. Our ideas may very well be their solution.

**DECKER AVIATION CORPORATION**

Philadelphia

### Switches for Rockets

Precision switch line for use in rocket applications and similar special applications are especially designed to resist high-temperature effects of propellant gases and adverse conditions found at exposed positions of high-speed, high-altitude travel.

Designated 21AS series, switches are high-capacity units attached to rugged cast-type actuator. Rear switching unit in a specified product under Military Standard MS 24131, the maker series Model 21AS1 is a 6-circuit double throw and 21AS2 is a single-pole single-throw.

Micro Switch, division of Minneapolis-Honeywell Regulator Co., Freepoint, Ill.

### Jet Blast Fence

An Erector jet blast fence utilizes simple structural steel framework, low-weight corrugated aluminum steel sheet bolted to a flat concrete pier. Steel sheets are especially selected to deflect blast vertically to dissipate its



energy, prevent blast from springing over the top of the fence.

A concrete base of similar character also is available for lighter temperature environments of the rocket type, as an expensive water-cooled fence is being developed for afterburner and other rocket applications.

Arco Engineering Co., Box 104, San Francisco 4, Calif.

### Reference Junction Comparator

Member reference junction can processor measures 10 in. x 5 in. x 12 in., weighs 12 oz., and is a bridge type unit which adds to the measuring circuit a third voltage measurement signal and opposite to the reference junction voltage, so that only measuring junction voltages are detected.

Almost any existing voltage source can be utilized and reference temperature can be pre-selected below lowest



### Truck for Liquid Oxygen/Nitrogen

Built to ASME and ICC specifications in 100-5,500-gal capacity liquid oxygen and nitrogen truck, truck transport units have bottom discharges and low-boy 40-ton quick pressure building system, standard steel valves on hand lines ending with quick coupling. Trailer is vacuum insulated equipment in all-steel. Builder is Hobart Laboratories, 21922 East St., Newark, N. J.

expected increased temperature to prevent instead of aircraft payload. Unit is portable after installation at high temperature. RTV Silicone-concrete floor being utilized at various and ultra static stresses.

Thermo Electric Co., Inc., Saddle Brook, N. J.



### Dynamic Strain Analyzer

PA 2A dynamic strain analyzer can handle a 400-cps shaper and amplifier for reading in mass level of about 5 mV, for manufacturer agents. Amplifier frequency response is flat from 5 cps to 50 Kc. An sensitive type strain gage can be used. Two strain measuring gages of  $\pm 5,000$  and  $\pm 10,000$  micro-inches per inch used. Available as a 10-year old, permitting

ports. Powered by a Continental engine, equipment can lift a 150-lb. steel plate at 5.7 mph, averaging speed.

Equipment is also adaptable to crane pulling, loading or in a pulling tractor. Sales Mutual Products, Inc., 4006 W. 47 St., Lyons, Ill.

### Servo System Analyzer

Model F Servo-type systems frequency is high to 100 cps and also provides low end coverage at 0.05 cps. Equipment gives sine, modulated sine and square wave signals in addition to



servo-type gain to peak measurements of dynamic strain. Maintenance is used by use of an low speed of amplifier.

Polyscope Instrument Co., Bridgeport, Pa.

### Magnetic Sweeper for Airports

Schrieber sweeps, designed by Schrieber, is designed to clear airport area of harmful foreign objects. It



## thermal thicket

The thermal barrier which now fuels the speed of jets: high speed aircraft can be cooled. Needed! Structural components of elevated temperature alloys. Problems. Finding the right alloy; making them easy to forge and machine with regular production line tools, maintaining uniformity of physical properties in production lots.

Right now, Carpenter is producing elevated temperature alloys which set new standards for consistent ability to meet tough aircraft specifications, high quality, improved ductility and machinability. Engine builders find them ideal for many critical parts. Forge alloys can work them to closer tolerances, get better finishes that require far less than usual machining. Work goes faster. Rejects are fewer.

You can get the full story of these alloys — their application, fabrication and engineering properties — in the new booklet, "Carpenter Alloys for Elevated Temperature Service." Get your personal copy by writing on your Company letterhead. The Carpenter Steel Company, 126 W. Bern Street, Reading, Pa.

# Carpenter STEEL

Improved alloys for elevated temperature service



bars: setup on four stages from 300 to 1200 rpm.

Older models accept outer diameters from .50 to 5.000 inches from the same source for the system being tested. Some Companies of America, 20-22 Ketchikan Temple, New Hyde Park, N. Y.



### Camera for Computers

Bottle Vericon camera for high speed and-out with computer and computing system picks up data directly from cathode ray tube projection, recording data in usual, user-to-file form. Special field flattening optical correct image distortions. Microstrip housing also sets image sharpness.

Camera holds 140 lb. of film. Film automatically advanced by an electric drive; exposures may be made at pre-determined or random intervals.

Photographic Products, Inc., 1400 N. Olive St., Anaheim, Calif.



### VTOL Velocity Recorder

Velocity recording unit that picks up angles of attack and velocity of flow speeds experienced in VTOL, or craft is being used by item to record true air velocity vector during transition flight.

Device is a spiral wind vane with two degrees of rotation. Two identical recording heads opposite each other measure vane deflection and pilot static pressure for heading during down velocity with inverted airflow. Unit weighs less than one pound and under two pounds.

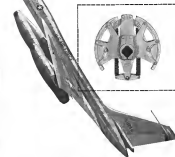
Yask Corp., Anaheim, Calif.

### Oxygen Regulator Weighs 1 1/2 Oz.

Member oxygen regulator weighing 1 1/2 oz and measuring 12 in diameter x 1 1/2 in thick, weighs one to eleven oz. can with several breathing, mechanical

AVIATION WEEK, May 12, 1952

manhandling the "Hustler" demands instant control response



PACIFIC REGULATORS maintain constant cable tension for precise control under ALL conditions!

With today's automatic speeds, faster climbing ability and higher ceilings the problem of maintaining instantly coordinated control is magnified.

Altitude and airframe temperatures vary under and after. Structural problems are aggravated by high speed design and the increased performance demanded. That's why automatic compensation of control cable is an absolutely important advanced performance feature, such as Corvair's new B-30 Hustler.

All the practical cable control systems on the B-30 are Pacific Regulators because these simple, mechanical devices continually compensate for both thermal and mechanical variations in the system — on any curve! The same automatic control response is available in all sizes — under all flight conditions!

In addition, Pacific Regulators offer a significant increase of the rated strength of the system because cable tension stays constant. This means a reduction in friction and wear in the system, and the cost, even in a very considerable weight savings.



Now Available — For complete information, write for our Pacific Regulator Catalog.

PACIFIC SCIENTIFIC CO  
P. O. Box 20015, San Diego 20, Calif.

126 INDUSTRIAL PARK FARMINGTON HAVEN  
BIDDING—BIDDING—BIDDING

MEMBER INFORMATION  
ALLEN ENGINEERING CO  
126 INDUSTRIAL PARK FARMINGTON HAVEN  
BIDDING—BIDDING—BIDDING  
MEMBER INFORMATION  
ALLEN ENGINEERING CO  
126 INDUSTRIAL PARK FARMINGTON HAVEN  
BIDDING—BIDDING—BIDDING

Member information, please send me your  
General Cable Regulator Catalog

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_

## NEW UNIVERSAL SYSTEMS



### meet 90% of magnetic tape data recording needs

You get all the precision and accuracy of a custom design and the off-the-shelf availability and dollar savings of a "package" design in Davies new Universal Tape Systems.

Every component has been designed to provide maximum flexibility consistent with overall system accuracy. Interchangeable electronic modules match the system to your individual requirements... now and for years to come. Specify a Universal System that satisfies your immediate requirements... adding tracks of data capacity as requirements grow.

Any one of the maximum of fifteen tracks provided can carry data recorded by any one of the three major techniques. Interchangeable Direct, FM, and PWM electronics assure you a total data recording system... able to handle each new job as it arises. Standard options are also available to meet the special needs of telemetering and multiplexed data.

Among the features of a Davies Universal Tape System never before available in "package" equipment are: tape speed at the flip of a switch... automatic switching mechanisms that match tape speed at the transport... precise phase coincidence of data among

all tracks... and facilities for electronic flutter-and-wobble compensation. Every item has been proved through years of service in jets, missiles, and on the ground.

Here's a brief review of the options available to you when specifying a Davies Universal Tape System that will grow with your recording requirements:

**Transport:** Standard (transport) offers up to six speeds, selectable at the flip of a switch. Fraction 100, 1/2" or 14" reels available for 1" or 1 1/2" tape. Three-speed transport optional for PWM systems.

**Reels:** In-line multitrack heads permit up to 15 tracks on 1 1/2" tape, assure precise time and phase coincidence of data among all tracks. Separate record and playback heads provided. Interleaved head stacks permitting up to 30 tracks on 1 1/2" tape, optional for telemetering, other applications not requiring data coincidence.

**Direct Recording:** electronics record and playback data from 100 to 100,000 cps. Ideal for high frequency data, also for recording complex wave forms made up of many frequency multiplexed signal channels. Random type discriminators provided for recording multiplexed data.

**FM electronics frequency modu-**

late a stable carrier with the data, to provide extremely accurate data reproduction, independent of tape variations.

**Pulse Width Modulation (PWM)** electronics permit up to 90 channels of quasi-sinusoidal data on each tape track. All PWM electronics are compatible with standard layers and decoding equipment.

**Flatten-Aid-Wear Compensation** electronically eliminates the effects of tape speed variation. Included as standard equipment whenever discrimination are used for data recovery, they can be accommodated by every Universal Tape System. Compensation permits FM channels of a Universal Tape System to preserve a high signal-to-noise ratio—better than 30 db at 30 cps, for example.

Complete information on Davies new Universal Tape System, and how they can satisfy your magnetic tape data recording needs is provided in Bulletin 2701. Write for your copy to: **Metroplex-Davies Laboratory Equipment Co., Davies Laboratories Division, 10721 Glenn Street, Beltsville, Maryland. Or call Webster 5-2700.**

**Honeywell**  
DAVIES LABORATORIES DIV.



taur errors. Low action required to open the regulator valve maintains high-speed pilot fatigue, naturally this rate braking mechanism as in a matter of tank leakage incurred by engine air leaking.

Dual function: also an automatic Regulator operates on a mechanical pilot valve principle and law with the demands of the user, does not slow down engine rotation, with an increase in altitude, a before drift action occurs upon pressure as accordance with a pre-determined barometric schedule.

Approved by: **Davies, Laboratory-Equipment Controls Co., 10721 Glenn Street, Beltsville, Md., Wash. D.C.**

#### Control Force Sensors

Control force sensor, adaptable to standard controls, eliminates back-out friction to permit pilot to maintain unerring control from these possible with manual control, according to the manufacturer.

Stick force per G and normal "feel" action may be varied or held constant and the performance range of any stick, and optional electrical output may



be included, if a stick. Pilot action full range of manual control, but may release the controls at any time for other cockpit duties. Units have been tested in several cockpits on the Douglas Mustang, F-100 and F-104 jet fighters. Equipment is available for cockpit stick, wheel and rudder pedals.

Unit, Inc., 110 Jones Ave., N.W., Grand Rapids, Mich.

# GET R.C. Allen

Proven-in-Flight

## RATE GYROS

The R. C. Allen deepened rate gyro is the result of fourteen years proven-in-flight precision instrument experience. Now in full production is a new precision, six-omni-tuned gyro, the R. C. Allen deepened rate gyro has a wide range of applications. The unit is small, efficient and hermetically sealed. Meets environmental conditions specified in MIL-E-2072A. Requires no heater for operating from -55°C to +45°C. We will design a prototype for your requirements and send on assignment for your evaluation.



### Turn and Bank INDICATORS

Get quality control to the most right standards with the R. C. Allen Turn and Bank Indicator, yet at tremendous savings in equipment costs. A standard model for all applications is available and now in use in thousands of civil and military aircraft. Manufactured to government specifications, MIL-S-7885 and CAA TSO C14. No special provision necessary for installation. 12V DC or 28V DC with dual mounting combinations to your specifications.



Write for information on R. C. Allen products... or send us your own drawings for price quote by mail on design.

**R. C. Allen Aircraft Instrument Division**  
R. C. ALLEN BUSINESS MACHINES, INC.  
321 Covertown Avenue, S.W., Grand Rapids, Michigan

# FLUTTER DAMPERS

by **HOUDAILLE**

... performance  
proved for every  
control surface  
application

When flutter free became a problem on high-speed, high performance aircraft, Houdaille launched an intense research program to develop high frequency flutter damping devices. Today Houdaille offers a wide range of designs in both rotary and linear types to meet any control surface problem—any aircraft requirement.

Houdaille Flutter Dampers are completely self-contained, precision-built hydraulic mechanisms—operated by leading aircraft manufacturers for their dependability and performance. Normally supplied with MIL-D-1506 fluid, available at all operational bases, they may be furnished with the new high-temperature fluids when specified. A thermometric air source reduces damping characteristics over a temperature range of -45° to 180°F and above.



**CONTINUOUS TESTING** and end quality control are standard procedure at Houdaille. Production tolerances meet military requirements since the overall design and engineering work is done to meet each one of the phases of the customer's specifications.

**WRITE FOR TECHNICAL BULLETIN** (free) complete performance and operational data. For engineering assistance on flutter damping applications at the aircraft design stage, contact Buffalo Hydraulics Division, Dept. AW.

Several authorized engineering organizations are available to complete product design for customers as desired.

## HOUDAILLE INDUSTRIES, INC.

BUFFALO HYDRAULICS DIVISION

537 East Delavan Avenue • Buffalo 11, N. Y.

Pioneers in developing aircraft vibration-control devices

## WHAT'S NEW

### Publications Received:

**Reviews of Space Travel—Ed.** by L. F. Carter—Pub. by Putnam & Company, Ltd., 42 Great Russell St., London, W.C1, England. Approx. \$5.00, 412pp. Scattered pieces of the British television Society which present the known facts about travel in outer space.

**Annals of the Royal Air Force 1915-17**—by Owen Threlkeld—Pub. by Putnam & Company, Ltd., 42 Great Russell St., London, W.C1, England. Approx. \$7.00, 510pp.

**Encyclopedia of all aircraft** which have served with the Royal Air Force since its inception on April 1, 1918 to the present day.

**Nuclear Power Engineering**—by Brian C. Schwab, Henry Ford Co., and Robert H. Shawcross, United Engineers and Constructors, Inc.—Ed. by R. G. A. Skelton of Power Magazine—Pub. by McGraw-Hill Book Co., 110 West 42nd St., New York 36, N. Y. \$6.95, 344pp.

This book, planned for engineers, technicians, and executives concerned with practical power development, gives a clear explanation of nuclear power plant design, construction, and operation as described in one convenient volume.

**U. S. Aviation Today**—Pub. by the National Aviation Educational Council, 1825 Connecticut Ave., N. W., Washington 6, D. C. \$3.95, 94 pp.

Detailing the latest aircraft, missiles, and atomic equipment, this booklet presents the achievements in aviation during 1956.

**The Gun Bar Story**—by Charles G. Madroske—Pub. by Robert R. Long, 1135 Belmont Drive, Wichita 4, Kansas. Over 100 pp.

This is the story of the General Electric's, their aircraft, and their contribution to aerodynamic engineering liberally illustrated.

**Automotive Tire Progress & Future**—by Magnus Pyke—Pub. by Philosophical Library, Inc., 15 East 96th Street, New York 16, N. Y. \$19.90, 391 pp.

As its title indicates, the book describes the latest of automation, not only automatic processes in various industries, and the factors affecting the speed with which it is likely to spread in different countries.

**High Speed Flight**—by E. Over and J. L. Taylor—Pub. by Philosophical Library, Inc., 15 East 96th Street, New

## NEW CALIDYNE 177 SHAKER SYSTEMS



for vibration test  
up to **5000 LBS.**  
**HORSE OUTPUT**  
with **411 LBS.**  
GFI. UH 10 1/2"

The Model 177 is one of a new series of "high-horse" shaker systems for impact frequency vibration test and for sinusoidal tests. It has three test to one capacity adjustment.

- 1. **SHAKER**—High torque, low frequency. Shaker 1 has two 500 lb. test to one capacity adjustment. Shaker 2 has one 1000 lb. test to one capacity adjustment. Shaker 3 has one 1500 lb. test to one capacity adjustment.
- 2. **TEST TABLE**—Adjustable height and load capacity. Shaker 1 has a 100 lb. test to one capacity adjustment. Shaker 2 has a 200 lb. test to one capacity adjustment. Shaker 3 has a 300 lb. test to one capacity adjustment.
- 3. **TEST TABLE**—Adjustable height and load capacity. Shaker 1 has a 100 lb. test to one capacity adjustment. Shaker 2 has a 200 lb. test to one capacity adjustment. Shaker 3 has a 300 lb. test to one capacity adjustment.

**SHAKER SYSTEMS FOR TESTED SHAKER SYSTEMS (177 SHAKERS)**

Model	Capacity	Weight	Frequency	Dimensions	Price
177-1	5000 LBS.	1000 lbs.	10-1000 cps.	10" dia. x 10" high	\$1200.00
177-2	1000 LBS.	200 lbs.	10-1000 cps.	8" dia. x 8" high	\$800.00
177-3	1500 LBS.	300 lbs.	10-1000 cps.	8" dia. x 8" high	\$900.00
177-4	2000 LBS.	400 lbs.	10-1000 cps.	8" dia. x 8" high	\$1000.00
177-5	3000 LBS.	600 lbs.	10-1000 cps.	8" dia. x 8" high	\$1200.00

For complete information on shaker systems, publications, test facilities, and accessories of the new Model 177 Shaker Systems, write for literature to: CALIDYNE CORPORATION, 1100 Industrial Blvd., New York 16, N. Y. 10018-1100. Telephone: (212) 341-1100. Telex: 270100. Cable: CALIDYNE. U.S. Patent Office: 2,715,177. U.S. Patent Office: 2,715,178.



THE ONLY CORP. AUTHORIZED DISTRIBUTOR



## NEW...

### TEFLON-GLASS FIBER LACING TAPE

New Dow-Har Beaded Lacing and Winding Tape combines two superior insulation materials—Dow-Flex Teflon and glass fibers. Fibers are Teflon coated before lacing to maintain close contact and assure tight knots—and to eliminate sloughing action of the glass. Dow-Har Tapes will not shrink and set through increased wear. They are suitable from -300°F to 300°F. They are non-flammable and inert to most known chemicals and oils—completely wet-free and fungus proof.

Available in 3/8", 1/2", 5/8" and 1 1/4" inch widths, in Off-white, Also available in 6 colors and black on special order. Write for prices and samples.

BENTLEY, HARRIS MANUFACTURING CO., 2105 Beverly St., Conshohocken, Pa.

BENTLEY, HARRIS *Sherlock* INSULATIONS

74 H. Over-Coding



# COMPLETE DESIGN FLEXIBILITY WITH EVERY TYPE OF SHOCK ABSORPTION FROM CLEVELAND PNEUMATIC



LIQUID SPRING ON  
LOCKHEED F-104 PROVIDES  
MAXIMUM IMPACT  
ABSORPTION IN LEAST SPACE

High-pressure seals developed by Cleveland Pneumatic provide lock-proof operation at static pressures up to 20,000 psi.

Any aircraft landing gear requirement you have can be solved by Cleveland Pneumatic. The gear can be designed around a conventional AEROL, a new-type high-pressure AEROL, or a Cleveland Pneumatic liquid spring. We engineer and produce all three types of shock absorbers.

If space aboard is extra-tight, the small-embage Cleveland Pneumatic liquid spring gives you the greatest shock absorption in the smallest package. Static pressures as high as 20,000 psi can be used.

Another weight- and space-saver is the high-pressure AEROL. It was developed by Cleveland Pneumatic to operate at 5,000 psi static pressure

with special CPT pressure seals. (Tests were successful up to 8,000 psi static.)

Tell us your landing gear requirements at the start. Cleveland Pneumatic designs and builds all types of landing gear, reassembles the type best for your service needs.



Write for the 8-page technical booklet which describes the principles of the liquid spring. Ask for "Booklet LS 12".

## CLEVELAND PNEUMATIC

TOOL COMPANY • CLEVELAND 5, OHIO



THREE PRESSURE-RANGES  
OF AEROLS SHOW BENEFITS  
OF HIGH PRESSURE

Comparison of (left) standard low-pressure AEROL, (middle) medium-pressure AEROL and (right) high-pressure AEROL. Note reduction in diameter of shock-absorber package.

Weight with Oil: 3.7 lbs.  
Height: 12.2" — 12.00 in.  
Stroke: 1.50 in.  
Pressure: 1000 psi

Weight with Oil: 2.6 lbs.  
Height: 10.2" — 9.80 in.  
Stroke: 1.50 in.  
Pressure: 5000 psi

Weight with Oil: 1.4 lbs.  
Height: 8.2" — 7.80 in.  
Stroke: 1.50 in.  
Pressure: 20000 psi



which of these

**WINSLOW**

services

do you need?



Word-Processed Reports



Quality Problems



Computer Controlling



Welding



Welding



Welding



Welding

**A CREATIVE ENGINEERING SERVICE FOR PRECISION METALWORKING**

For any precision manufacturing plant, Winslow offers a complete engineering service that covers everything but actual design of the product and its actual manufacturing. This service is based on years of working in close cooperation with all of the country's aircraft engine manufacturers and as Winslow's large investment in manufacturing research.

Starting with your part print, Winslow studies out process problems, determining how the part can be efficiently produced. Equipment is specified and fast-planned. Special machinery needed is designed and built by Winslow, as well as special tooling and jigs. Assembly and assembly control procedures are set up.

Winslow's large staff of engineering designers and manufacturing experts represents long experience with a great variety of difficult problems. Winslow has consistently set up a number of plants for computer manufacturing. All of Winslow's consulting services or any part of it—is available to you.

**WRITE FOR ENGINEERING BROCHURE**

Winslow's "Engineering Brochure" describes in detail the Winslow consulting service, tells how Winslow works with customers. Includes an actual case history of typical Winslow jobs and the Winslow customer list.

Winslow's Bulletin, *Half Second Bench Depth* on the method of the jet engine industry for turbine engines, cylinders and shafts tested, also other turbine parts, also turbine turbine "remanufacturable parts" details all such and developments, give *Write Today for Loss Money* "Write for literature

**WINSLOW MANUFACTURING CO.**

CLEVELAND, OHIO  
15000 East 25 Street, No.  
1000 Auto. Avenue, 25.  
VAN NUYS, CALIF.  
1000 Honey Building

York 16, N.Y. 51800, 227 pp.  
This book, covering the latest special problems, and correct methods of process and equipment related to high speed and supersonic flight.

**Viscous Flow Theory II: Turbulent Flow**—by Staff J. Zan-Fab by D. Van Nostrand Co., Inc., 120 Alexander Street, Princeton, N.J. 50 75, 277 pp.  
The second in a two-volume work on viscous flow theory, this book presents for the first time a detailed and systematic treatment of the fluid dynamics of turbulent flow.

**Energy**—by Sir Oliver Lodge—Pub. by John F. Rider Publishers, Inc., 110 West 14th Street, New York 11, N.Y. 51 35, 64 pp.  
This is a professional report of the original work dealing with the forms of energy and making clear features of concepts.

**Automata**—by Alexander Schaefer—Pub. by John F. Rider Publishers, Inc., 110 West 14th Street, New York 11, N.Y. 51 53, 88 pp.

Volume 14 in the Electronic Technology Series by Dr. Schaefer, it covers both theory and practical applications. Transistors form the basic devices in put amplifiers, polarizers, etc. from the basic diode through parametric oscillators, long wire and other antennas.

**Wave Propagation**—by Alexander Schaefer—Pub. by John F. Rider Publishers, Inc., 110 West 14th Street, New York 11, N.Y. 51 35, 64 pp.  
This book deals with the fundamental nature of electromagnetic induction covering the various forms as related to the industry and transmission of electromagnetic waves, with emphasis on the properties of these waves.

**The Concept of the Antenna**—by Norman Kopy—Pub. by Philosophical Library, Inc., 15 East 44th Street, New York 10, N.Y. 50 75, 152 pp.  
As science cannot bring together all available information on laser-type experiments, Brazil, New Zealand, Australia, Russia, which are, this year, exploring Antarctica.

**ASTM Standards on Petroleum Products and Lubricants**—Available from the American Society for Testing Materials, 1515 Race Street, Philadelphia 3, Pa. 57 50 cloth-covered volume, 56 71 paper-covered, 1076 pp.

Includes tentative and standard methods of test, specifications, dimensions of items and classifications of petroleum products and lubricants with related information. The present edition includes 183 standards, 45 of which are new or revised since the previous edition.

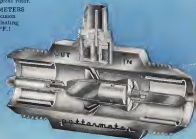
**COCKTAILS FOR ROCKETS**



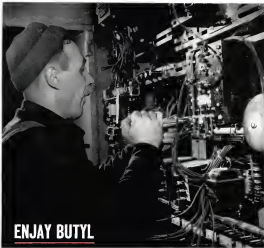
**Well blended!** Rockets are meticulous drinkers. They like their liquids mixed in precise proportions. That's why in missile and rocket ground testing and airborne telemetry, Potter Electronic Flowmetering Systems have become standard equipment. The POTTERMETER is the only flowmeter which features the hydraulically positioned, heretofore rotor.

For more than 18 years, POTTERMETERS have been successfully used for precision measurement of viscosity and pulsating flow of fluids from -455°F. to 1000°F.!

Write TODAY for Bulletin A-2



**POTTER AERONAUTICAL CORP.**  
U. S. ROUTE 222 • Union, New Jersey • MU'dock 6-3010



**ENJAY BUTYL**

*electrical wonder rubber* OFFERS TRIPLE VALUE

Performance Versatility Economy! In all uses, Enjay Butyl is the world's outstanding rubber value. In a wide variety of applications, Enjay Butyl rubber stands unmatched in its ability to resist ozone and corona, impact and abrasion, moisture and weathering... properties that contribute to the outstanding performance of Butyl-made products.

Instrument transformers, underground service cables, high voltage industrial cables... in these, and many other electrical applications, Enjay Butyl out-performs and out-lives all other types of rubber, synthetic or natural. Low-cost and readily available, this truly wonder rubber may well be able to cut costs and improve performance in your products. For further information, and for expert technical assistance, contact the Enjay Company.



Pioneer in Petrochemicals

ENJAY COMPANY, INC., 25 West 51st Street, New York 18, N. Y.  
 Alton • Boston • Chicago • Los Angeles • New Orleans • Tulsa



Enjay Butyl is the greatest rubber value in the world... the super-durable rubber with outstanding resistance to aging • abrasion • tear • slitting • stretching • ozone and corona • discoloration • gases • heat • cold • sunlight • moisture.

## AVIONICS

# Solid State Advances, Trends Detailed

By Philip J. Klaus

New York—Solid-state components which permit an electronics circuit repeat design in much or most of the end device is the transistor has done in the past decade were described here during the annual symposium on The Role of Solid State Phenomena in The Air Cavalry.

More than 900 scientists and engineers, including representatives of firms half a dozen foreign countries, heard Dr. Paul P. Benoit, chief solid state physicist in field of joint efforts whose surface we have only started to penetrate.

Enslaved as head of the Physics Department at Polytechnic Institute of Brooklyn, whose Microwave Research Institute sponsored the symposium in association with the Air Force (Office of Scientific Research, the Office of Naval Research, the Signal Corps Engineering Laboratories and the Institute of Radio Engineers.

### Military Interest

One indication of the military importance of solid state physics is the fact that the commanding officers of chief technical centers of all three sponsoring military agencies were present to address the symposium.

• Brig. Gen. Earl E. Cook, Signal Corps Engineering Laboratories chief, called solid state physics "a veritable gold mine" in its potential for the military case.

• Brig. Gen. H. T. Gosselin, chief of the USAF's Office of Scientific Research, and Dr. Thomas J. Kilian, chief scientist of the Office of Naval Research, both lauded the newly developed Massachusetts microwave amplifier as a potential breakthrough in the radar communication fields. Both said

### Revolution In Components

Technicians that was so doing now felt, a view that has no moving parts, a flexible capacitor that can be electrically tuned and proven that operation of low impedance in apparent violation of basic laws of electromagnetics are some of the outstanding components coming out of solid state physics research which are described in Avionics World's report on the second symposium on Solid State Phenomena in Electric Circuits.

Five members took to accurate Mass development and applications.

Dr. M. W. P. Strandberg of the Massachusetts Institute of Technology led Dr. J. C. Arlman of Harvard as invited on first. Major developments noted by Dr. P. E. Mass of the British Royal Aircraft Establishment, in a talk with no moving parts which can be switched from on to off with the application of a magnetic field.

• **Diodeless computers.** Multi-decade transistor which provides resonance between input and output (input circuit, or vice versa, with no moving parts) was described by Dr. G. C. Skolnik of Westinghouse Electric Corp. (p. 8). Hill was co-author of the paper.) Switching times as short as 1 microsecond and power handling of nearly 100 to 50 watts appear feasible, with isolation of 70 db or better between adjacent circuits, Dr. Skolnik indicated.

• **Low-noise-circuit amplifier.** Some conductance amplifier which accepts no r.f. input signal, converts it to hard signals which no noise corrupts the amplified dc output was described by Dr. R. E. Hildner of General Electric's

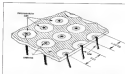
can be changed by a factor of 3.1 by varying its bias voltage suggests that modified version of present design may be used in voltage-tunable variable capacitors and low-capacitance amplifiers, Hildner suggested.

• **Low impedance field emitter.** The field-effect device, a solid-state device now used in numerous applications to initiate a radio transmitter from inverted reflector, is not has not to overcome disadvantages and open up interesting low-frequency circuit possibilities, Hildner said.

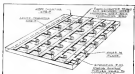
• **Magnetic modulation.** Induce automatic, a promising and versatile new semiconductor control whose conductivity changes sharply when subjected to a magnetic field, can be used as a stable nonreciprocal phase constant in varied circuits by changing the applied magnetic field. Another application of the same principle, also suggested by Dr. P. E. Mass of the British Royal Aircraft Establishment, is a rate with no moving parts which can be switched from on to off with the application of a magnetic field.

• **Diodeless computers.** Multi-decade transistor which provides resonance between input and output (input circuit, or vice versa, with no moving parts) was described by Dr. G. C. Skolnik of Westinghouse Electric Corp. (p. 8). Hill was co-author of the paper.) Switching times as short as 1 microsecond and power handling of nearly 100 to 50 watts appear feasible, with isolation of 70 db or better between adjacent circuits, Dr. Skolnik indicated.

• **Low-noise-circuit amplifier.** Some conductance amplifier which accepts no r.f. input signal, converts it to hard signals which no noise corrupts the amplified dc output was described by Dr. R. E. Hildner of General Electric's



MINISTRAL low-cost reworking unit is portable vinyl supported board with etched August-type holes covered with photoconductive material which can be etched by electron beam. Means for capacitor reworking (right) employ same principle.



# LEWIS

Indicating Pyrometers

for temperature testing  
in the laboratory  
or in the process...

Constructed with the same care as our aircraft temperature indicators, these pyrometers bring "aircraft quality" to the test engineer.



**MODEL 1000**, above, has been used extensively by Eastern aircraft operators for flight testing on the "Warning Recorder" — safety device which records in color color before time. See flight record which can be easily reproduced for routine inspection. Made in rugged metal body, with accurate three-needle meters.



**MODEL 1001**, left, above, has been used extensively by Eastern aircraft operators for flight testing on the "Warning Recorder" — safety device which records in color color before time. See flight record which can be easily reproduced for routine inspection. Made in rugged metal body, with accurate three-needle meters.

**MODEL 1001**, right, above, has been used extensively by Eastern aircraft operators for flight testing on the "Warning Recorder" — safety device which records in color color before time. See flight record which can be easily reproduced for routine inspection. Made in rugged metal body, with accurate three-needle meters.

**STANDARD BATTERY—AIR MOUNT**  
**PARABATTERY**  
Type 100, 200, 300, 400, 500, 600,  
800, 1000, 1200 and 1500.  
**CENTRYRACE**  
Type 100, 200, 300, 400, 500, 600,  
800, 1000 and 1500.

Furnished with 6000 wires, thick metal legs and rollers on wide flange angle iron, leveling and padding of special die cast metal and EPOXY "Thermite" resin, Lead and Exhaust Shields with wide dimensions.

**THE LEWIS ENGINEERING CO.**  
Manufacturers of Complete Temperature  
Measuring Systems for Aircraft  
WABSHUTE, CONNECTICUT



**SOLID-STATE IMAGE** — microwave amplifier with very low noise characteristics, opposite to other major gain in tube and conventional. Miles is seated in Miles is high.

Research Laboratory GE has constructed microwave amplifiers with power gains of 70,000. Dr. Helmut reported. Advantages of the device, in that high speed amplifiers and electron tubes between input, output • Microwave, infrared modulators. Modulation of radio output, by varying a flow rate of electrons in a microwave and applying a control current at high voltage field to it was reported by Dr. J. W. Gosselin of the British Radar Research Establishment. (A. E. Gibson was co-author.) Two such modulators tested could handle radio pulse repetition rates up to 100 per second and pulse widths of one microsecond. However, their reports state that the device should be able to operate at rates up to 10<sup>10</sup> per second. Cross-beam modulated beams have been tested in the infrared spectrum with only limited success using germanium but Gosselin believes that the use of silicon will overcome these limitations.

#### Photoconductive Switching

Use of photoconductive techniques to provide a relatively low-cost, non-toxic, high-speed switching device, was suggested by Jesse E. Rosenthal (N.Y. A. Stryker) in a paper published by his husband. Both are employed at the Miles R. DeMotte Laboratories.

The switching characteristics of photoconductive areas show that that that their dark resistance of about 100 megohms drops sharply when illuminated to about 1,000 to 100,000 ohms, depending upon the material and amount of illumination.

Good candidates suggested by the

Researcher consists of a series of well designed shaped areas (0.15 in. outer diameter) etched on a supported plastic board. Incoming leads are attached to only the copper strands (through holes). The design was shaped areas separating these strands from the common copper conducting surface are then coated with a photoconductive material.

#### Switching Leads

To switch any one of the incoming leads to the common conductor, it is not necessary to focus a small spot of light on the photoconductive area, causing its resistance to drop sharply and permit current flow. To provide a light source for light-speed switching, the board with the photoconductive elements is placed up against the face of a cathode ray tube. By positioning the CRT electron beam, it is possible to illuminate any photoconductive switch as high as to be activated.

To provide a full switching matrix for computer logical circuits, a set of parallel conductors is etched on one side of the copper clad board, and another set is etched at right angles on the opposite side. Each of the conductors on one side is connected to a row of photoconductive elements. The other copper strands of each of these dough nuts in turn is connected to one of the parallel conductors running at right angles to those on top.

To connect any one of the top conductors to any one of the bottom conductors it is only necessary to select and illuminate the proper area.

Mr. Rosenthal reported that the

## BULLETIN: THE CARAVELLE IS NOW ON AMERICAN TOUR



first to get off the ground in jet transports—

## LEAR TRANSISTORIZED AUTOPILOTS

AT THE VERY DAWN of the jet transport age, Lear automatic flight controls are already in the air guiding Air France's Caravelle jet transports on route indoctrination and demonstration runs. And when the Caravelle enters regularly scheduled passenger service next year, the first all-transistorized airliner autopilot, a Lear L-17, will be at the controls, providing standards of safety, accuracy and comfort beyond a human pilot's ability.

Manufactured by Bob Aviation of France, the Caravelle is scheduled to visit the following cities: WASHINGTON, D. C., May 8-10; ATLANTA, May 12-15; MIAMI, May 18-20; DALLAS, TX, WORTH and HOUSTON, May 21-23; KANSAS CITY, May 25-26; ST. LOUIS, May 27-31; CHICAGO, May 28-June 3; DENVER, June 3-5; SALT LAKE CITY, June 5; LAS ANGELES, June 5-10; SAN FRANCISCO, June 10-12; SEATTLE, June 11-17; CLEVELAND, June 15-18; NEW YORK CITY, June 20-22; MONTREAL, June 20-23.

SEE THE CARAVELLE AUTOMATIC PILOT



## Frozen on the outside, warm and ready to go on the inside!

*The "Mars" makes the difference*

**EXTREME COLD** in Arctic operations has little effect on the compact, reliable Mars auxiliary power unit used on the Boeing KC-97 tanker. Often running outside every day in cold dry air, the dependable Mars powered generator set keeps the cabin comfortable at below-zero temperatures. It supplies electric power also for engine preheating and starting systems as well as for other auxiliary equipment.

Solar's 30 hp Mars gas turbine is the heart of the auxiliary power unit. The Mars engine weighs less than



300 pounds, is smaller than a two-foot cube. It starts easily from 150F to -65F ambient temperatures, operates on a variety of fuels, is simple to maintain, and requires no engine overhaul. In addition to the KC-97, Mars auxiliary power units are employed on the Douglas C-119C, the Lockheed C-52C and Convair C-111B.

Perhaps the Mars gas turbine can help solve your need for a light, compact, powered engine. Write to Dept. D-25, Solar Aircraft Company, San Diego 12, California, for more data on the Mars gas turbine.

### WRITE FOR BROCHURE

New literature describes Solar gas turbines—how they work, how you get them, why. Ask for a copy.



**SOLAR**  
AIRCRAFT COMPANY

440 NORTH  
540 WEST

\*Mars is the registered trade mark for Solar's line of 30 hp gas turbine APUs.

### Research Pays Off

Direct military gains from basic research which seeks knowledge and understanding instead of being devoted toward specific military objectives is pointed up by recent developments in solid-state physics.

Five years ago the military services were criticized for supporting extremely low-temperature research because it had no obvious military application. Yet one of the research has since the new Mars microwave amplifier which the military services are now looking at is a potential product of a technological breakthrough in the radio and communication fields. The Cyclotron, another new device which stems directly from low-temperature research, promises a major reduction in the size and cost of digital computers.

End of the pay-off is not in sight.

photoconductive dopants can be spaced with their centers approximately 0.1 in. apart, making it possible to produce 15 such switches on a square inch. This should make it possible to produce a matrix of 1,000 switches in an area of roughly 40 square inches, or a 16,000 switch matrix on a board measuring only 3 1/2 x 3 1/2 in.

The technique appears to have the advantages of relatively low cost and simplicity of manufacture. Another advantage for certain applications is the ability of the photoconductive switches to operate at high potentials, 500 to 1,000 volts.

Maximum switching speed of the device depends upon the amount of output current required. If an output current of a few milliamperes is sufficient, switching speeds up to 50 megacycles are possible. Max Baerley reported. Higher currents will require longer switching times.

### Indian Antimonicide

As a semiconductor material for transistors, indium antimonicide has as far proved to be a complete dud. Yet the material has remarkable properties, stemming in part from its very low energy gap, which promise a host of interesting new microcircuit devices. Indian antimonicide shows extremely high magnetic resistance effects. For example, when subjected to a 16,000 gauss field, it experiences an 1,800% change in resistance, compared to the 6% change first noted in germanium. Dr. T. S. Mani reported. This prompted him to suggest that the new material could be used as a magnetically controlled potentiometer without sliding contacts and as a relay without moving parts.

Indium antimonicide could also be

used in microphones to provide an extremely high output signal, sufficient for a self-powered telecommunication system without further amplification. A new type power rectifier, which Moss calls "magnetic barrier layer" is another interesting possibility. It would consist mainly of a slab of uniform width, antimonicide with abrupt (partly) p-n junctions, operating in a magnetic field. Back-to-front resistance ratios of 10,000:1 should be possible, Moss predicts.

"A whole family of new devices stem from the use of the Hall effect where indium antimonicide has a power efficiency 300 times greater than germanium," Moss said. Here are some of the applications suggested by Dr. Moss:

• Sensitive compass, capable of providing an output signal sufficient to drive a compass indicator.

• Highly sensitive magnetometer, responsive to as little as 10<sup>-7</sup> gauss.

• Low-loss capacity impedance granule, when used with bridging networks in a nonreciprocal network, can provide very low forward transmission losses.

• Motor torque sensor. Placing a small piece of indium antimonicide in an electric motor stator and as it is subjected to the same field and connecting it to the statoric winding results in a Hall-effect voltage which is proportional to the motor's instantaneous torque. This voltage can be used for monitoring or control purposes.

• Analog computer multiplying element.

• Direct-coupled a.c. voltmeter.

• Modulator.

• Half-effect piezoelectric amplifier, capable of power gains of 63.

One of the most important uses of indium antimonicide, for industrial detectors, Moss said. The reason is that the space wavelength limit of sensitivity can be easily controlled by changing its impurity content. At room temperature, indium antimonicide has an operating wave length (EPR) power of 40 cm with peak response at about 6 microns, Moss said. At low temperatures the wave length can be extended out to about 7.8 microns, he added.

### Knowledge, Not Devices

Despite the flooding list of impressive new semiconductor devices, primary emphasis perhaps may be placed on acquiring new knowledge and techniques rather than new devices.

For example, Dr. H. Knesner of RCA Laboratories reported on techniques for coating the equivalent of billions of electron and hole magnetic dipoles within a semiconductor material in a controlled manner. He calls these "core-electric" and "space-magnetic" fields. Dr. Knesner's current studies are an extension of the discovery which led to the recent "Gulf transistor," which



Aircraft Assembly  
Engineers prove it:

LAMINATED SHIMS OF

**LAMINUM**  
STEEL METAL 100% THE ALUMINUM

SAVE TIME! CUT COSTS!

With all limitations smoothly surface-bonded, LAMINUM looks and acts like solid metal, yet slaps 2-4-in. for a thousandth 81-right at the job.

✓ IN ALUMINUM with limitations of 80%

✓ IN STAINLESS STEEL with limitations of 60% or 80% in 304 Steel and Inconel

Newly published Engineering Data File contains detailed information. Write for your copy! There's an advantage!

LAMINATED STEEL CO., INC.  
3100 Woodlawn Lane 1112  
118 Union St., Glenview, Ill., Ill.





**Texas Instruments transistorized timing devices offer new highs in timing / reliability / application**

- No moving operational parts
- Accuracies up to one part in 10 million
- Interval time accuracies in months
- Inherently rugged without servicing
- With 1/2 the space, 1/2 the weight, a small fraction of the power needed for these hours or other methods
- Decided order of applicable BIL specifications

Already in production, TI transistorized timers are being new timer in applications and in performance — with extraordinary accuracy and with inherent resistance to many impairments never before practical because of size, weight, power drain, and maintenance limitations.

Designed for repetitive or continuous sequential timing or programming, these lightweight, dependable timers are now in production at Texas Instruments for use in camera timing, flow dropping, batch release, mass logging, and assembly placement. There are just a few of many potential uses. And, since modification and adjustment is not required, these remarkable TI timers can be built to meet specifications within reasonable lead-time. Contact Application Division...

 **TEXAS INSTRUMENTS**  
INCORPORATED  
3905 LEMMON AVENUE DALLAS 5, TEXAS



**3-D Radar Tracker**

Trichromatic system, capable of automatically tracking up to 75 targets in three dimensions is a hybrid digitizing device. Each incoming a processed as video, takes while display is controlled digitally by a digital computer which controls and displays information on all 75 aircraft tanks. Developed by Westinghouse Electric Corporation's Electronic Division in Richmond, new device employs 1,500 transistors and 45,000 diodes. System has been under test for 30 months.

can operate at very high frequencies. The gas-electric and magnetic fields are modulated by a non-linear frequency distribution of segments within the resonator and in setting up various forms of elastic stress. This makes it possible to construct perfectly the effect of transiently matter experience. Hence by increasing the user's high frequency response.

The technique produces effects which in some cases would otherwise require the most delicate in use, as local controls in other cases it produces unusual effects which no external controls could duplicate. Dr. Koenigs reported.

Other possible applications suggested by the quasi-optic fields in a solid state configuration, but Dr. Koenigs indicated that this is not an immediate project.

**New Materials**

Until recently, designers of sensor detector devices and transducer materials, such as silicon or germanium. Basic research in solid state physics has now opened up a tremendous number of new materials, most of them semiconductors. A few of the more promising according to RCA's Harold, solid state physics research, include silicon and silicon phosphide.

Another new material, silicon on sapphire, shows considerable promise for extremely high temperature applications, according to Dr. F. E. Williams

**Marquardt Is Growing...**  
offering new opportunities to professional engineers



ROBERT L. EARLE, Executive Vice President, is shown in foreground of the Marquardt engineering-production team. He is shown at Marquardt's new production plant now under construction at Ogden, Utah.

Freedom to pioneer — freedom to grow — these are the challenges and new engineering opportunities at Marquardt Aircraft.

Through these freedoms, Marquardt stands established as the leader in ramjets, "powerplant of the future."

Through these freedoms, Marquardt leads the way into advanced engineering projects.

These freedoms — pioneering and growth — are as individual as each professional engineer, as collective as the entire Marquardt team. Through them, Marquardt now offers new and unlimited opportunity for professional engineers in two of the West's most stimulating areas. At Ogden, Utah, in the heart of the Wasatch Mountain vacation area, Marquardt is now constructing a multi-million dollar production plant to produce

supersonic powerplants for the Boeing Banshee interceptor missile. And in Southern California's San Fernando Valley, Marquardt professional engineers are involved in a major expansion program for design, development, and test of new ramjet engines and turbojet and turbofan controls.

If you are a professional engineer interested in the freedom to pioneer — the freedom to grow — for yourself and your company, we invite you to investigate the opportunities at Marquardt Aircraft, today. Please contact Jim Dale, Professional Personnel, 16651 Satlow Street, Van Nuys, Calif.

**marquardt** AIRCRAFT CO.  
VAN NUYS, CALIFORNIA GREEN, UTAH

FIRST IN RAMJETS



Normally, in producing welded pipe, the weld is made at the top. But gravity plays a nasty trick. It keeps it from settling in the weld zone, pulling it down toward the middle of the pipe. The result, particularly in the heavier gauges, is a permeable bridge where it hurts the weld—right on the inside surface. If you try to get rid of the bridge—at four cost—the metal is oxidized—and corrosion and erosion start there.

## why there's **NO BEAD—NO UNDERCUT**

But Trent got a step to that—simply by going into partnership with gravity. With their exclusive Contour-Welding process, they weld at the bottom—and gravity works for them. For that, the bridge is on the opposite direction—bleeding in perfectly with the contour of the pipe itself.



## ...with new **CONTOUR TRENTWELD**

New Contour-Trentweld stainless pipe and tubing is so smooth, both inside and out, that you can't even feel the weld. It's stronger, more uniform, with no place for corrosion or erosion to get a toe-hold. And it's available in any size or gauge... in all stainless, high-alloy, Hastelloy and titanium grades that can be welded.

**CONTOUR  
TRENTWELD**

**Stainless and High Alloy  
Welded Tubing**

TRENT TUBE COMPANY, GENERAL SALES OFFICE, EAST TROY, WISCONSIN (subsidiary of Crucible Steel Company of America)

of General Electric's Research Laboratory. General Electric has just announced that it has operated a silicon carbide rectifier at temperatures up to 1,200° and as low as -100°.

Dr. Guy Suits, vice president and director of GE's research, says, "Although currents of several amperes have been carried with stable efficiency, the practical future of silicon carbide as rectifiers and other solid state devices will depend on progress in the processing of the highly stable but extremely inchoate material."

### Future Gains

Symposium speakers in general displayed the customary reticence of scientists to make predictions beyond the present limits of knowledge.

In a symposium on solid state devices, the consensus was that we further gains in the upper frequency limit of transistors probably would be accomplished by improved techniques for controlling the lateral geometry of the transistor surface than have any new materials. However, the group agreed that the possibility of some new compound capable of providing higher frequency operation could not be ruled out.

ICV's Hovind predicted that it should be possible to fabricate complex solid-state circuits capable of performing several functions. This futuristic vision under other circumstances is neatly reported by *Aviation Week* (April 8, p. 80).

### SPSS FILTER CENTER SSASL

► **Mass Development**—Bronx Eastern is developing a four-state Mass (solid state) receiver amplifier for Rome Air Development Center to enable it to evaluate new device's performance in order and receive communication systems. The four-state Mass, under investigation at Massachusetts Institute of Technology, may be limited to probe-type operation. Three-state Mass under investigation at Harvard can reportedly be used for both point-to-point CW type service, but has other limitations. Other groups active in Mass development include Columbia University, Bell Telephone Laboratories, General Electric, Hughes Aircraft Co., Radio Corporation of America, and Westinghouse Electric.

► **Electronic Refrigerator**—Bell Telephone is investigating research interests and other techniques for semiconductor compounds for possible application to electronic refrigeration, neither and side heaters. Bell's interests say that Bell's interests has theoretical capacity to cool and lightly as directly



## **ELECTRONIC CONTROLS**

### For Aircraft and Missiles

Thompson experience, skills and facilities—free design through production—see ready to go to work for you. You can count on Thompson for development and production of electronic control sub-systems and components, components and microwave components. We invite your inquiries.



Aircraft Controls



**ELECTRONICS DIVISION  
Thompson Products, Inc.**  
200 SHARPOOD ROAD • CLEVELAND 8, OHIO



## communication is a sometime thing

Lips encouraged to voice new theories helped make possible modern rocket power. You—for the sake of our nation's safety—our lips must remain sealed to our secrets.

RMI has long been known for its "open and shut" communication—for its encouragement of creative discussion not only within RMI but also with others who are working to advance America's cause . . . and for its constant vigil to protect America's secrets. For over a decade and a half, RMI engineers and scientists have been cooperating wholeheartedly with our nation's security program as they blaze new trails in developing and producing today's . . . and tomorrow's . . . powerplants.

Engineers, Scientists—Perhaps you, too, can work with America's top rocket family. You'll find the problems challenging, the rewards great.

**Power for Progress**  
**RMI REACTION MOTORS, INC.**  
DENVER, NEW JERSEY

402

without reacting to compression, using DeLaval effect. (For explanation of DeLaval coning, see AVIATION WEEK, May 23, 1955, p. 51.)

► **M-H Inertial Guidance**—Mississippi-Alabama Research Corp. reports it is flight testing an inertial guidance system called BIP. Used for Inertial System, Inducting Position Flight has staged over several hundred mile courses, M-H says.

► **Small Ducts Important**—This is rather thin as it between a turbine as either component and equipment design can reduce heat conduction from the ducts to the gases. Sols not recommended by at least one turbine manufacturer is to place drop of silicone oil between component and duct.

► **Some Seatspot Are Good**—Contrary to popular belief, some seatspot actually improve noise transmission, Radio Corporation of America reports based on recently completed 30-year study of noise transmission RCA's study indicates that seatspot which are rich in ultraviolet light have a favorable effect because they strengthen the membrane John Nelson of RCA Company, Inc., who made the study, has developed theory that seatspot are the result of collective action of the gravitational field of solar system planets circling the sun. On the basis of his theory, Nelson has been able to predict noise output actively with an accuracy of better than 95%, RCA reports.

► **Man-Made Electron Cloud Tests**—To determine the degree to which radio signals will bounce off man-made ionospheric clouds created by releasing zinc smoke from a rocket in the upper atmosphere, will begin early in July. Tests, sponsored by Air Force Cambridge Research Center, will be conducted at Holloman Air Development Center, and will utilize the aid of some of America's "Chari" radio apparatus in the midwest.

► **Data Converter Comes**—Massachusetts Institute of Technology will hold five-day course in analog-digital conversion techniques, starting Aug. 12. Program will be under direction of Alfred E. Susskind of MIT's Electrical Engineering Dept. in cooperation with the Servomechanisms Laboratory. Tuition is \$75.

► **Electronic Communications, Inc.** is now name of Air Associates, changed by vote of shareholders to reflect more accurately future plans of company. Air Associates name will be retained in a division. Gradual relocation endeavor will place all manufacturing and

engineering operations at Ft. Peck, Ft. Peck, and new research laboratory is under construction at Timonium, Md.

► **Ducts Tests Soon**—North Atlantic evaluation tests on Ducts language navigation system are slated to begin soon. Ducts is the British competitor to the U. S. Navstar system for adoption by International Civil Aviation Organization. Two Ducts systems as Newfoundland are in operation and two English systems will soon go on the air. Ducts Navigation Co. reports Major North Atlantic routes will participate in system evaluation, Ducts says.

► **New Business Following**—Various companies have recently announced receipt of major new contracts:

► **Federal Telephone & Radio Co., Chicago, Ill.**, has received \$1.2 million contract from Air Material Command for "vector computer." Details of the equipment and its use are classified, FT&R says.

► **Foresworth Electronics Co., Ft. Worth, Tex.**, has received additional orders amounting to approximately \$12 million from Boeing Aircraft Co. for ground support and test equipment to be used with the Boeing ground-based missile.

### PASSENGER COMFORT ASSURES REPEAT TRAFFIC



## Flight in Fancy

This model, and a host of other aircraft seat designs, have been styled to suit any conceivable plane interior. From upholstery to the full-ervey Aerotherm, this seat offers your passengers the ultimate in comfort and safe relaxing flight in fancy. Aerotherm seats are the choice of major airlines the world over and their performance is attested to by repeat orders.

For the comfort and safety of your passengers and to assure repeat business, investigate the Aerotherm seat. Contact our Project Engineers, The Thermix Corporation. Ask for technical details.

Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.  
10000 Connecticut Ave., Suite 100, Silver Spring, Md.  
London: Atlantic T. C. ORDWAY LTD, London, E. C. 4, England

**Manufacturers**  
**THE AEROTHERM CORPORATION**  
Beverly, Calif.





2500 ACRE SCIENCE CITY



AVIATION RESEARCH LABORATORY



POOL OF EXPERIENCED SCIENTISTS



SPORTS AND CULTURAL ACTIVITIES

# RESEARCH and DEVELOPMENT in San Antonio

An opportunity for you to open new research frontiers... See San Antonio offers an ideal location for the research which will create your future.

SCIENCE CITY is a 2500 acre site which has been specifically planned as an ideal location for plants engaged in research and development and technical manufacturing.

Southwest Foundation for Research and Education, the Army Ordnance Center, new laboratory research laboratory and a new residence laboratory to be used in aviation research.

Laboratories are available under very flexible plans requiring no capital investment.

The location of Southwest Research Institute, Brooks Army Medical Center, and the new Army Ordnance Corps' laboratory research facility in San Antonio has created a pool of experienced scientists, engineers and technicians from which we can draw a nucleus for staffing new research and technical manufacturing plants.

In addition, thousands of workers skilled in the production and maintenance of electronic equipment, aircraft and aircraft parts, and metal fabrications, heavy machinery, textiles and others are abundantly available.

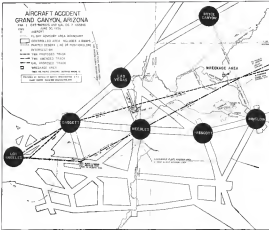
See San Antonio's CLIMATE PLUS as cultural and scenic attractions make enjoying of research personnel less difficult than in other laboratories. Here, scientists and their families can enjoy living in a heavenly and world atmosphere.

They can hunt and fish on fresh water lakes, less than one hour's drive from the city. The delightful Hill Country is just minutes away and the charm of Old Mexico and the thrill of deep sea fishing or swimming are within three hours' drive.

## SAN ANTONIO City in the Sun

Write Greater San Antonio Development Committee, 700 Insurance Building, San Antonio, Texas, for complete information. All incomes treated in confidence.

# SAFETY



COURSE of TWA, United Airlines flight established on space map at Fort St. Vrain position box.

### CAR Accident Investigation Report

## Visual Failure Blamed in Canyon Crash

An approximately 1031 $\frac{1}{2}$  June 13, 1976 a Twin Otter airplane, Lockheed L188A, N18802, and a United Air Euro Douglas DC-7, N 6342C, collided in about 21,000 ft over Grand Canyon, Ariz. Both aircraft hit the Colorado river at the confluence of the Colorado and Little Colorado rivers. There were no survivors among the 125 persons aboard the flight. 73 aboard TWA and 52 aboard United both aircraft were drowned.

### Twin Otter Airliner

On June 13, 1976 at 2001, Twin Otter Airliner Flight 2, a regularly scheduled passenger service, took off from runway 15 of the Los Angeles International Airport. Flight 2 was en route to San Diego, Calif. Flight also flew San Antonio, Calif. to Reno, Calif. via Van Horn, Ariz., Amber, Ariz., 2. Departed about 19:00, about 19:00, via Van Horn, Ariz., Amber, Ariz., 2. Departed about 19:00, about 19:00, via Van Horn, Ariz., Amber, Ariz., 2.

The flight also passed a canyon about 19:00 ft, a final approach of 270 ft, and a departure time of 20:10. The Twin Otter flight crew consisted of Capt. Jack E. Cowley, Captain James H. Rogers, Flight Engineer James D. Berkeley, Flight Engineer Gary W. Alvin (released as an additional crew member), and Helman Trapani. A. Anderson and Jack D. Duin. Preparation for Flight 2 was routine except for departure time delayed a few minutes by minor adjustments on the aircraft.

The flight was degraded with 1,300 gal of fuel and the fuel manifold closed. The gross weight of the aircraft at takeoff was 108,113 lb, well under the maximum allowable of 111,200 lb. The fuel was properly distributed with respect to weight of gross location of the aircraft.

As reported, the flight after takeoff was below the Los Angeles tower radar detection, altitude, and was received through an enroute which passed in the Los Angeles area. After reporting "no top" (2,400 ft) the flight contacted the Los Angeles Air Route Traffic Control Center (located in Los Angeles Center) frequency, 112.9 mt., to do an enroute clearance. The clearance specified the heading as filed on the flight plan. However, the clearance specified that the flight climb to 19,000 ft in VFR conditions. Subsequently, the flight

# LEADERSHIP:

## automatic flight control

*Aer Lingus . . . another airline selects the world's finest control system*

Collins Automatic Pilot controls the aircraft in all modes of flight with unequalled smoothness. Its advanced features improve steering interpretation, dependability, and control. As an integral part of the Automatic Pilot, Collins Integrated Flight System presents the pilot with a continuous picture of flight attitude and navigational status.

The new Aer Lingus fleet of Fokker F-27 "Friendships" is being equipped with Collins Automatic Pilot, Integrated Flight System, ADF, VHF, VOR/ILS and Marker Beacon Receivers, HF Transmitter, and Compass System. Collins equipment is also on order for Aer Lingus Vickers Viscount 907s.



### COLLINS IN GROUND COMMUNICATION

Collins engineers design and equip the equipment facility and put into operation integrated multi-channel communication systems of one type. The Collins system engineering staff is located at the base of equipment in the world, whether domestic HF, HF or VHF Transmitters, beacons, emergency relay and indicators or single channel HF. Typical of Collins communication progress is "Reliance" — a high speed data transmission system, meeting communication capacity.



### COLLINS IN AMATEUR RADIO

In the early 1930's Collins set the standard in amateur radio sets. Through continuous design and development, his latest line stands in its prime — single channel station — the most advanced and priced in the Amateur frequency. This latest in the line conforms to the 100-watt or more 10-meter 80-meter and 40-meter sections. ICA-4 receiver and logic selector. ICA-4 exciter. Many of the leaders in the amateur radio bands associated with Collins through the country's amateur radio equipment.



### COLLINS IN AVIATION

Collins completely equips airline, military and business aircraft with the most advanced communication equipment. Auto control and instrument systems in service. Many new lightweight radio-alarms systems are now being developed. Collins designed the original Integrated Flight System, leads in standby communication sets into a single channel "OR" package for new military aircraft, and continues to pass the industry in development in airborne radio, ADF, ILS, VOR, HF and VHF communication.



### COLLINS IN COMPONENTS AND TEST EQUIPMENT

The degree of precision and stability of Collins products requires development by Collins engineering of components such as Amplifiers and Auto-pilot/Intermittent Motor, oscillators, test relays, tube shields and sockets. These devices made and other high quality components are sold by a Collins subsidiary, Communication Accessories Company of Holman Mill, Missouri. The great majority of accuracy and reliability depend on Collins test equipment, built especially for Collins but adaptable to testing other equipment types.



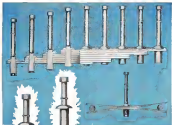
# Collins

CREATIVE LEADER IN AVIATION ELECTRONICS



COLLINS RADIO CORPORATION, BRIDGE PLAZA, ST. LOUIS 8, MISSOURI • NEW YORK • WASHINGTON, D.C. • MIAMI • SEATTLE • COLLINS RADIO COMPANY OF CANADA, LTD., TORONTO • COLLINS RADIO COMPANY OF ENGLAND, LTD., LONDON • COLLINS RADIO INTERNATIONAL S.A., PARIS • TOKYO





Excellent hole filing characteristic of Cherry "700" rivet also allows an even surface finish above. Top piece also demonstrates that various internal thicknesses can be riveted successfully with rivets of identical length. Lower illustration shows high clench achieved with "700" rivets.

## CHERRY "700" Aircraft Rivet Gives More Effective Fastening

The "700" rivet is versatile and its design covers one length of each diameter will cover all thicknesses of material. Also, the sheet hole size is not critical as well as when rivets are used the design provides positive hole fill even in oversize holes. The stem always adjusts to fill the hole which affords high rivet retention independent of hole size.

The recess in which the "700" rivet is set provides both clutch by drawing the sheet together tightly and acquisition. When the "700" rivet is set, the stem shoulder protrudes above the sheet head and gives visual indication that the rivet was set properly formed, the sheet hole is filled and the rivet is properly set.

\*Values listed and pending

## CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

### Townsend Company

ESTABLISHED 1816 • NEW DIVISION, 1944

is Exclusive Franchisee - Aircraft Manufacturing Company, Ltd., Gloucester, Ontario

striking rousing sound and aft. Also, as the rivet sets on the lower wing or fuselage there were numerous black rubber marks and additional scratches. The marks and scratches ran diagonally up and reached about 15 deg. as rivets in the wing were set over line.

The pieces of the DC-7 left alone were found appearing like top sets attached to fuselage skin. These marks were evenly spaced around and around and both lower lower portions of black rubber marks on their lower surfaces.

Between stations 517 and 521 the wing leading edge of the DC-7 was delaminated around and around. Sawed and it was marked on the lower leading edge was continuous through series of deep fork like markings they were made before the leading edge struck the object causing back log. At the leading edge of the lower wing surface there were more scratches and they ran around as a single of rivets about 15 deg. relative to the rivet set in this specific area there was no evidence of the black rubber marks.

### DC-7 Wing Skin

At the L-1049 wreckage area a section of lower wing skin from the DC-7 was found. This section was from the left wing a few inches above engine nacelle and had four points of marks - 6" and 1 1/2" large marks transposed diagonally to those previously described. Indicated in a line on the part was a piece of Consolidated head stamp and so the air ribs were found. Areas stamped marking on the skin, ground debris on the scratches was the rivet set in Consolidated hole size and stamp at the previous skin area.

A second area of damage equivalent to the investigation objectives and closely allied with the DC-7 wing design on the Consolidation components. This area had marks that passed around but were in line on a straight position about 112 marks north of the comparison of L-1049 wreckage. It was generally in a line except for the left and right end and ends. Respectively these signs found about 30 marks between the skin distance of the airplane from the rest of the L-1049 together with the evidence of some damage when it was separated from the left leading edge and this damage components had rivets in flight after collision impact. However, pieces of the L-1049 left wreckage structure and all features of damage were found west of the area TWA's wreckage site. Light aircraft material from the left wreckage were found on Cape Selkirk. It will not, indicating that there were two or three sets of a collision altitude to date this distance.

The pieces from the Consolidation component were separated away from the main wreckage at sufficient distance to indicate separation prior to ground impact. These, consisting of sections of the left upper leading edge of the fuselage, a section of the left and right edges of the Consolidation rib above second column outside. The piece was removed on a leading edge of the fuselage on the left side of the wing (right side is left). The recess area which provides a fit for the damage on the DC-7 left wing tip. The rivet set was on the wing tip hole from the left edge, and the black marks resulted from contact with the fuselage

leading edge door boot. The second piece, which listed below the second piece, was compared to the left by the same hole.

The L-1049 left wreckage was a dual set of column damage. Most specimens was a piece of leading skin about 1 1/2 x 4 ft. in size. Identification shows it came from the upper right side of the Consolidation bracket and forward of the tail. Its outer surface was ground when it was set. This rivet was bent around about 90 deg. so that its outer surface was facing north and other. There were not, however, and black marks as noted elsewhere on the sheet outer surface part at the set of the lead. In addition to these marks there were two deposits on a metal surface, one slightly angled above and the other below. Together with these there was also long grey air marks protruding in the same direction as the markings. Placement of the rivet hole marks within the deposits was located on the upper edge. This evidence indicated that the grey deposits were made by an object moving up and along the recessed ribbed flange of the Consolidation bracket.

The final set of suggested damage was the left rib damage of the L-1049. It was a series of three profiles cut on the lower and bottom flange to the vicinity of the last baggage compartment. The cut was generally vertical and showed a lot of varying lengths. They were carefully parallel about 31" apart with the middle cut about 11 deg. relative to the largest cut and the rest of the cut. All three parts were at the edge of one cut in the baggage cut was compared with the post screws on the DC-7 wreckage.

Two additional profiles also were located in the L-1049 lower flange. One cut was approximately in line with the L-1049 No. 1 baggage cut and the other was about 10" forward. The damage was not consistent with the above evidence damage and the rivets were probably made by the profile of the Consolidation being ground damage.

### Other Areas

Other areas of both aircraft were as rivets in the collision. Some were rounded up or conical to the right and some were rounded up or conical to the left. Although important to other reasons, rivets were probably made by the profile of the Consolidation being ground damage.

Investigation showed that special and unique specimens were made for the flight. The TWA, Consolidation left in flight after collision impact. The specimens and except for minor discrepancies an identical characteristics, was a good condition. The DC-7 was checked at Los Angeles and it was determined that there was no mechanical discrepancy or any other items. The flight engineer had performed preflight and preflight inspection.

Both flights were placed at high altitude operations above 10,000 ft. over of the 100 deg. indicated which only correct operations and operations were performed then to be placed and flew all within one direct course to the advantage of the flight to avoid weather and fuel flow to it as well as the desired distance between origin and destination of the long range crossing flight. Below flight however, a definite flight path was noted on the wing sheet with its corners tapering points indicated in clearly below the proposed



## For those "impossible" installations Cherry Research Offers The 3/32" MONEL Hollow Pull-Thru Rivet

Available with either stainless or 304 stainless head, the Cherry 3/32" Monel Hollow Pull-Thru Rivet has a high shear strength, has been developed in fastening metal plates, using aluminum and honeycomb materials where extremely limited space makes use of solid rivets difficult. Usage in surrounding material in these difficult spots is eliminated with the pull-thru hollow

rivet. Simplicity and speed of installation cut costs and save weight. The new 3/32" Monel Hollow Pull-Thru Cherry Rivet can be installed with all existing Cherry Rivet guns, including the G-25 Hand Gun.

For technical information, write to Townsend Company, Cherry Rivet Division, P. O. Box 2157-N, Santa Ana, Calif.

## CHERRY RIVET DIVISION

SANTA ANA, CALIFORNIA

### Townsend Company

ESTABLISHED 1816 • NEW DIVISION, 1944

is Exclusive Franchisee - Aircraft Manufacturing Company, Ltd., Gloucester, Ontario



BE SURE

TO SEE...

*An on-the-spot telecast  
from Andrews Air Force Base,  
Washington, D. C., where the  
Armed Forces demonstrate  
POWER for PEACE*

# THIS IS DEFENSE

MAY 19th, 4 to 5 E. D. T., LIVE-OVER THE CBS TELEVISION

NETWORK...SEE YOUR LOCAL NEWSPAPER FOR STATION LISTING

Sponsored by **WESTINGHOUSE**  
DEFENSE PRODUCTS DIVISIONS

24200

road to be built. To the east, extensive open-pit high-ashade mines have been established. From there, the road eventually is selected for individual operations.

Control of heavy construction projects on a highway project is not restricted on an IFR, in VFR light plan but the area near the road permits flights to be flown in instrument weather conditions regardless of the flight plan showing that portion of the flight is over it. In this regard, Texas World Airlines' policy at the time of the accident, provided at intervals flight in instrument weather conditions but such as an IFR flight plan with an assigned altitude. Traffic operating 3,000 ft top the company reported adherence to visual flight rules.

#### Bricked On Weather

The pilots were briefed on the anticipated weather conditions before flight time. These indicated conditions with ceiling levels in the 1000 and for the planned duration of the flight. Captain Gandy with each 15,000 ftng hours, had flown the subject aircraft approximately 177 times and was well qualified. Captain Miles, with 11,000 hours had flown the aircraft once. On October 1975, and he also was well qualified. The other crew members of both flights were experienced. All according to documentary evidence was rated in good physical condition, completely qualified and certified for their positions.

The flight operated as a visual mission in this program section. Except for the brief extension of United 714, the reports were without indication of any difficulties.

calls. The individual company dispatch offices followed the progress of these flights in a regular manner.

Approaching Dugart the TWA flight was to be cleared to an altitude above 21,000 ft on its IFR flight plan and at 21,000 ft on top. The TWA's radio operator who received the report from the flight called Los Angeles ATIS and at 0501 advised "TWA 1" is coming up on Dugart reporting 21,000 feet. The Los Angeles controller then contacted the Salt Lake ATIS controller and told "TWA 1" is operating two one thousand feet above the level. I got to be Dugart down. Meanwhile, I see you have United 714 crossing his altitude—how low is it now on Dugart?" According to the recording of the conversation the Salt Lake controller replied, "The flow comes out and they are right together." The Los Angeles controller then called the TWA radio operator and said, "Advisory TWA 1, unable to operate two one thousand." At the time the radio operator interrogated and told "Just a minute. I think you want a clearance on top 1200 ft. I'll be on top and be on top of it." After determining from the flight through the TWA radio operator, that it was clear 1,000 ft on top the Los Angeles controller issued the following amended clearance, "ATIS clear TWA 1, unable to clear 1,000 ft on top. Advise TWA 1, 2, hold traffic at United 714, descent Dugart, remaining Nucleus at 0507." The TWA ground radio operator stated that the clearance was given "TWA 1 and 2" was cleared back to base clearance by the flight. The operator said that at this time

reports by the instrument operator United 714, asking that it was at 21,000 ft which he contacted from the ground station although the altitude was not part of the information from the controller. The TWA operator notified that he assigned Captain Gandy's voice and that the signal was relayed to the instrument crew on the United flight as "traffic is cleared."

#### Controller Testify

The two controllers participating in this action were called to testify at the Board's public hearing. In response to questions they submitted because "TWA 2" would not pass from the Los Angeles ATIS was of responsibility to the Salt Lake area, it was necessary to maintain the TWA's report to the controller. Each stated that at this time the flights were IFR traffic operating as unclassified airports and ATIS was reported to separate them from each other as well as from any other aircraft on IFR clearance. The controller who gave the clearance was not alerted the United clearance from the TWA operator as to compliance to the final of 21,000 ft and as a traffic advisory.

The Director of the CMA Office of Air Traffic Control advised that when TWA's reported 21,000 ft the flight had not cleared Dugart on but the United flight cleared Nucleus. They were not traffic for such advice at that time but in preparing that traffic advised both would cross Red Arrow 15 with ill-defined horizontal separation. On that evening ATIS was reported to separate the flights, that TWA was de-

## LIGHT BENDER!

This 24-inch F/4 lens has a 4-inch diameter entrance pupil, covers a full size plate, and yet fits into a 2 1/2-inch chestnut!

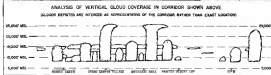
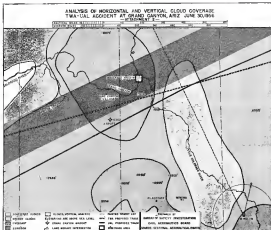
The trick was to design a lens that could bend the light accurately through such a small diameter, to take advantage of its economy and high speed system.

It took some doing, but we developed and are manufacturing in quantities a new P.A.S. technique, to take the same and applying this to the GRAP that applies to glass systems in the project.

Want files to help with your optical problems, too. We have the largest independent facilities on the West Coast containing research and development, as well as production and precision production of glass and plastic elements or lenses.

Give us a call.

**PACIFIC OPTICAL CORP.** 132 Clayton Ave., Inglewood 1, Calif. Phone: GUYton 4-0418



CLOUD COVERAGE is depicted horizontally in this chart which accompanied the CMA report. Crosses and cross bars are shown

and 21,000. The witness added that the separation was in ATIS responsibility for instrument flight only in the controlled airspace and that Red Arrow 15 was the last rule seen by the pilots to terminate as they were well beyond the control area. He said the ATIS messages and papers, information with respect to IFR flight being through unclassified airspace, and that the information is used for the purpose of providing a high speed flow of instrument traffic was not controlled except to be cleared. He stated that as

traffic control does not provide no control space as function is unclassified airspace. The witness explained that flight area was not based by clearance or flight plan, whether VFR or IFR, while operating in unclassified airspace and that instrument traffic was only lower and within a control area according to traffic control clearance. The controller, annual of control operations (ANC Manual) stated that "Class space instrument flight within control area and control area only is unclassified space

operation of aircraft outside these areas is unregulated." When TWA's assigned altitude was 1,000 ft on top of instrument clearance the rule given to United 714. The Director of Air Traffic Control stated that since was cleared through the flight area in controlled airspace at the time. The clearance in TWA's 1 was to maintain 1,000 ft on top which a rule in a control area. The witness said the flight was not intended to be specific altitude as control area except that

it is at least 1,000 ft above the ground level from which the radio is transmitted so space and under certain conditions of limited visibility flight should be conducted in an altitude consistent with the "Clear of Ground Rule." The second rule is that the aircraft thereafter did not know what altitude Captain Conroy would adopt in a crossing altitude so it he might later change the altitude from take to land. The first rule stated that such altitude as appropriate, the TWA flight at that time was VFR flight and that the basic VFR clearance applied for it to maintain flight in VFR conditions.

"Civil Air Regulations do not provide a definition for 1,000 as the minimum altitude or a merely controlled airspace but, even with respect to enroute operations as outlined in the Flight Information Manual and other data, it is less than 1,000 ft on top (10,700 ft) can be used as an IFR flight plan or adapted to IFR as an IFR clearance or use of a crossing altitude through the type of application as the responsibility for avoidance of collision with other aircraft on the pilot, the flight as an IFR operation and must obtain an assigned clearance for a specific altitude before proceeding into IFR within conditions" is further stated. "No Traffic clearances which specify a crossing altitude are issued and as far as a crossing altitude point light is considered in any altitude or it shows the clearance on each altitude (MEA)

which is 1,000 ft or more above the cloud base." The present concept for separation of air traffic and avoidance of collision in VFR weather conditions requires flight plans to be filed, and the concept of a minimum altitude to provide separation visually between aircraft. Civil Air Regulations do provide flight separation capability at the pilot and the concept as commonly used is based on the "see and avoid" principle. Radio assistance and sight of one aircraft and the "see and avoid" principle in respect to an IFR flight operating in VFR weather conditions. The flight information manual states "During the time an IFR flight is operating in VFR weather conditions, it is the direct responsibility of the pilot to avoid other aircraft, using VFR rules, even when operating on the same route as a VFR aircraft. VFR is considered with other provisions the best guarantee of being able to avoid the "see and avoid" rule, although with help or no external traffic control assistance.

#### Report on Needles

At 0715 World Flight 712 reported its position to the CAN communications station located at Needles. This report indicated that the flight was over Needles at that time as altitude was 20,000 ft and it extended further the Pointed Down line at position of 1011 [covering the position estimate of 104]. The flight was

and it would therefore report over Denver. The traffic controller for Needles issued the report, according to minutes received in the Albuquerque center at 1011 and to the Salt Lake center about 11:24. The communications stated that for working the report to Salt Lake was issued by an enroute pilot. The controller of Salt Lake receiving the report was the one who subsequently was involved in the decision which caused TWA 2 to approach 712. The report was approximately 10:21.

At 0730 Utah World Flight 2 reported its position to company radio located at Las Vegas. The flight reported it had passed over Lake Mead at 0755, was 1,000 ft high at 20,000 ft and continued reaching the 321 deg. radial of the Willow River enroute. After Pointed Down line of position of 1011, with Pointed-up the best reporting position. In response to the ground communication reported back the Las Vegas and told the flight that the ground was falling rapidly. At 10:07 the Las Vegas TWA communications personnel forwarded this position report over before his withdrawal to the Salt Lake center. This report was received by the CAN traffic controller at 10:11. The same controller received the position report of World 712 at 10:13 from the CAN Needles communications.

During the public hearing the Salt Lake controller told the CAN Director of Air Traffic Control was questioned as to whether or not traffic advisory information

should have been issued the flight when the controller had received position reports from both flights and knew both were flying at the same altitude, observing the Pointed Down line at the same time as the report on enroute position. The controller stated that when the report was received from World 712 he had no knowledge that World 712 either flight would climb to the top of position because both were in the enroute area and a specific track was not required. He said the Pointed Down line of position is nearly 175 mi long with an altitude position within this distance. The controller stated that, in this instance, he did not know they would converge; that he merely had both would pass the line southwest of that line. He indicated that he was not reporting the position or direction to flight which was in uncontrolled airspace and it was only a clear source that he was controlling it. He also said that advisory service would not be possible in a 10-to-15 minute interval control of flight and some altitude position in formation, or with additional position information.

#### Director Testifies

The CAN Director of Air Traffic Control testified concerning the situation, stating that it was not the policy or intent of Air Traffic Control to provide traffic within minimum altitude of controlled airspace. He said and corrected such information could be of help later. Most aircraft continue to Air Traffic Control and he would not be possible in a 10-to-15 minute interval control of flight and some altitude position in formation, or with additional position information.

The witness testified that with respect to these two particular flights, the controller, instead, knew about this, however he is pleased that advisory information was not provided in this situation as an advisory operation. He stated that advisory service for traffic in uncontrolled area would be furnished in positive control of air traffic which would require personnel, facilities, and equipment not presently available. He added that this was because he is correct, having advised that altitude information would be provided in advisory service or advisory service was issued to the controller. He concluded that the present assignment of service assigned to perform the one pilot's function as he was controlled in the controlled performance of the aircraft. Both flight paths could then announce between position reports until the separate communications were in the Pointed Down line of position. He stated that position of 1011 was TWA Area Lake Mead.

According to the United States the flight would make the Pointed Down at 10:11, as it is located after passing Needles. Investigation showed the altitude received at 10:11, approximately 37,000 ft, as nearly 100,000 ft, and that the position of report position. Consistent in another United States, 700, a DCV, which showed the unit course to draw at 20,000 ft, approximately 100,000 ft. Flight 712 should have reached the Pointed Down

## RF POWER AMPLIFIER

- rugged
- compact
- reliable

Model 202 Amplifier



Provides 10 watts output from 2 mA rms input. Rugged construction and the use of a stacked magnetic tube makes this amplifier stable and reliable over a wide range of environmental conditions.

Temperature—55° to +75°C  
 Size—1 1/2" x 1 1/2" x 1 1/2"  
 Vibration—5g, 20-2000 cps  
 Altitude—0-70,000 feet

Write for complete data and price.

**RADIATION INC.**

RESEARCH AND DEVELOPMENT CORPORATION

Personnel Inquiries Invited

## RFM TELEMETRY TRANSMITTER

- small size
- low distortion
- high reliability
- high frequency stability

Model 2021 Transmitter



An extremely rugged unit designed for high shock impact and extreme environmental conditions. Subminiature format and crystal stabilized.

Frequency Range—218-835 mc  
 Power Output—2 watts  
 Weight—1.7 pounds

Write for complete data and price.

**RADIATION INC.**

RESEARCH AND DEVELOPMENT CORPORATION

Personnel Inquiries Invited

\*Civil Air Regulations, Parts 91.21, 91.1, 91.2, 91.3, 91.4, 91.5, 91.6, 91.7, 91.8, 91.9, 91.10, 91.11, 91.12, 91.13, 91.14, 91.15, 91.16, 91.17, 91.18, 91.19, 91.20, 91.21, 91.22, 91.23, 91.24, 91.25, 91.26, 91.27, 91.28, 91.29, 91.30, 91.31, 91.32, 91.33, 91.34, 91.35, 91.36, 91.37, 91.38, 91.39, 91.40, 91.41, 91.42, 91.43, 91.44, 91.45, 91.46, 91.47, 91.48, 91.49, 91.50, 91.51, 91.52, 91.53, 91.54, 91.55, 91.56, 91.57, 91.58, 91.59, 91.60, 91.61, 91.62, 91.63, 91.64, 91.65, 91.66, 91.67, 91.68, 91.69, 91.70, 91.71, 91.72, 91.73, 91.74, 91.75, 91.76, 91.77, 91.78, 91.79, 91.80, 91.81, 91.82, 91.83, 91.84, 91.85, 91.86, 91.87, 91.88, 91.89, 91.90, 91.91, 91.92, 91.93, 91.94, 91.95, 91.96, 91.97, 91.98, 91.99, 92.00

## NEW MODEL 21 AMERICAN MECHANICAL INERTIA REEL HAS WIDE ANGLE OF INERTIA RESPONSE

An entirely new shoulder- harness take-up reel, built and approved under Spec MIL-E-8236, Type MA-1.



1. Has assembly with angle of inertia response. Lacks tripping hazard portion of forward horizontal inertia response, which is the cause of most injuries. Forward horizontal inertia response gives harness line only by light panel material, and does not trip reel.
2. Can be locked, either by inertia or manually, to maintain it any angle.
3. New inertia-bearing mechanism provides shock locking and cable retaining action.
4. When not in locked position by inertia or manually, will harness cable extended, the harness cable will retract from the reel when it is released from cable.
5. Angle of assembly, with respect to horizontal axis of aircraft, is not fixed.

6. Thinner reel—1 1/2" over all. May not retract and extend cable any type "hook".
7. Manual control operates on all portions of line of harness. Power push pull control cable provides direct manual operation with lock on adjustable seat.
8. Uses new mounting hole spacing to allow use of one manufacturer.
9. Easily serviced. Manual control cable cable, as well as such as replaced without disturbing other components. Harness cable can be replaced easily by service personnel.
10. Simple structure for easy development.

Model 21 Inertia Reel

We also make Inertia-Reel back restraining to Spec. ANR-27. Attachment 2 and 3 are standard. Both are built to MIL-E-8236, Type MA-1. Type MA-6 also available. Write for complete data book.

**AMERICAN SEATING**  
 GRAND RAPIDS 2, MICHIGAN  
 WORLD'S LEADER IN PUBLIC SEATING



## **Bridgeport** BELLOWS AND ASSEMBLIES PERMIT GREATER DESIGN FREEDOM

Bridgeport bellows bring an extra assurance of strength, safety and stability to any bellows application. And to help you realize these advantages to the fullest, Bridgeport can supply bellows in the best form for your requirements. There's a choice of single or multiple-ply construction, many different heads and ends, sizes from 1/2" to 375" O.D., and a wide variety of metal—brass, phosphor bronze, beryllium copper, stainless steel, steel.

With its specialized engineering staff and all-new plant, Bridgeport is also better able to integrate the engineering and production of complete bellows assemblies. The latest high-speed, precision equipment and quality control facilities enable Bridgeport to supply any assembly at lowest cost... with uniformly high quality.

SEND FOR BELLOW'S ENGINEERING BULLETIN #A



**Robertsaw-Fulton**  
CONTRUCTION COMPANY



in its estimated design loss. Other performers of the search also blamed the estimate could have been made.

The Flight 1 also was making good its estimate in a divided tunnel Lake Mead. The obstacle was a second side-escorted performance of the Constellation and the light entered it would reach the Flaming Desert of 1950 or 19 months after passing Lake Mead. The flight also was approximately 14 minutes long because of its estimated position when the collision occurred.

Which still was carefully reviewed to determine whether or not they could have been a factor in the delay. It was believed that these could have been in consideration of altitude and speed little from the woods below.

### **Time of Accident**

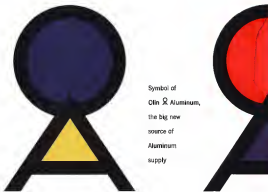
Determination of the time of the accident was in question since the flight's description. The aircraft damage sustained by the United States Navy left questions but that the search ended soon after the collision and therefore the last transmission from an air base was close to the end of the time. Knowing the recording that occurred the transmission also contained two radio and reported others in actual time it was believed that the message began at 10:10 P.M. when the United States had heard the last message in its transcription but with reliable information that the voice was that of Fair Office Station.

The recorded transmission itself was also reviewed under laboratory conditions to determine what the exact message was whether or not anything was said which was completely under actual listening conditions and whether or not the message was reduced through all or part of the recording. The latter objective would mean to determine whether or not the DC-7 crew reported the E-120 during the transmission and if the aircraft crashed during it. The analysis was based on a comparison of the spoken words with a spectroscopic analysis, a method used as "Visible Speech." Even so, relying on actual listening and speech recording was the main.

The flight itself showed the principal speaker was "Bill Lake, one (or two), seven (or eight) on an air base." The message for time represented by the dots a second speaker spoke and it was only which was "up" or "on." The speaker also talked words which sounded "up." These were indicated by "Bill Lake, one (or two), seven (or eight) on an air base." The second speaker showed that the principal speaker throughout was speaking between 200 and 250 cycles per second, which is the speech spectrum. The background or second speaker's pitch was even higher, being well above that of a female voice but it was fairly certain that it was a male speaker. According to the laboratory study both ground voice patterns, particularly as to pitch, showed the speaker was older and somewhat deep-sounding than they were always at voice levels.

An electronic search to determine if the flight collision was associated. Many

\*Differences between flight history and laboratory results relative to message content are indicated.



Symbol of  
Olin Aluminum,  
the big new  
source of  
Aluminum  
supply

## OLIN ALUMINUM

brings you an important new concept of  
Quality and Service designed to cut your manufacturing costs

Olin Aluminum is already being produced at four locations. Soon, backed by a multi-million dollar investment and the extensive experience of Olin Industries Chemical Corporation in the new serious metals field—Olin Aluminum's new, ultra-modern facilities will be ready to produce 100,000 annual volumes of more than 240 million pounds of fine aluminum.

The full integration of these new facilities—Olin Aluminum's new state-of-the-art Aluminum Plant, Reduction Plant, Rolling Mills and Fabrication Plant—will assure dependable delivery of Olin Aluminum to you. And the advanced technology and design of

these facilities plus the experienced skill of the men who will operate them will mean competitively superior metallurgical quality, tolerances and finish for every sort of Olin Aluminum.

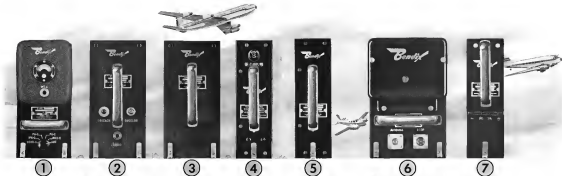
That is Olin Aluminum's new concept of Quality and Service: fine Custom-Made Aluminum so tailored to your individual needs that it will save you manufacturing operations, delivery and service on quantities that costly delays will be eliminated, and technical assistance so thorough and inspired that it will assure you maximum economic use of every ounce of Aluminum.

The men from Olin Aluminum are already making calls on industry. Soon they will be coming your way. Meanwhile, we cordially invite your inquiries. Write to: Olin Aluminum Division Sales, Olin Industries Chemical Corporation, 460 Park Avenue, New York, 22, N. Y.

**OLIN**  
ALUMINUM

© 1957 Olin Industries Chemical Corporation. All rights reserved.





**1** **100 HZ VOR RECEIVER**—This receiver meets the 100 HZ VOR Receiver performance required for use in Class II airports. It is a compact design, and it contains a built-in antenna. It is available in either 100 Hz or 150 Hz versions. Weight: 10.5 lbs. Size: 10 1/2" x 10 1/2" x 10 1/2".

**2** **75 HZ VOR RECEIVER**—Designed to meet the 75 Hz or 150 Hz Receiver performance required for use in Class II airports. It is a compact design, and it contains a built-in antenna. It is available in either 75 Hz or 150 Hz versions. Weight: 10.5 lbs. Size: 10 1/2" x 10 1/2" x 10 1/2".

**3** **VOR RECEIVER WITH 75 HZ OR 150 HZ VARIABLE**—This receiver meets the 75 Hz or 150 Hz Receiver performance required for use in Class II airports. It is a compact design, and it contains a built-in antenna. It is available in either 75 Hz or 150 Hz versions. Weight: 10.5 lbs. Size: 10 1/2" x 10 1/2" x 10 1/2".

**4** **VOR RECEIVER WITH 75 HZ OR 150 HZ VARIABLE AND 100 HZ VARIABLE**—This receiver meets the 75 Hz or 150 Hz Receiver performance required for use in Class II airports. It is a compact design, and it contains a built-in antenna. It is available in either 75 Hz or 150 Hz versions. Weight: 10.5 lbs. Size: 10 1/2" x 10 1/2" x 10 1/2".

**5** **VOR RECEIVER WITH 75 HZ OR 150 HZ VARIABLE AND 100 HZ VARIABLE**—This receiver meets the 75 Hz or 150 Hz Receiver performance required for use in Class II airports. It is a compact design, and it contains a built-in antenna. It is available in either 75 Hz or 150 Hz versions. Weight: 10.5 lbs. Size: 10 1/2" x 10 1/2" x 10 1/2".

**6** **VOR RECEIVER WITH 75 HZ OR 150 HZ VARIABLE AND 100 HZ VARIABLE**—This receiver meets the 75 Hz or 150 Hz Receiver performance required for use in Class II airports. It is a compact design, and it contains a built-in antenna. It is available in either 75 Hz or 150 Hz versions. Weight: 10.5 lbs. Size: 10 1/2" x 10 1/2" x 10 1/2".

**7** **VOR RECEIVER WITH 75 HZ OR 150 HZ VARIABLE AND 100 HZ VARIABLE**—This receiver meets the 75 Hz or 150 Hz Receiver performance required for use in Class II airports. It is a compact design, and it contains a built-in antenna. It is available in either 75 Hz or 150 Hz versions. Weight: 10.5 lbs. Size: 10 1/2" x 10 1/2" x 10 1/2".

## NEW LIGHTWEIGHT NAV/COM SYSTEMS

*New Bendix® Equipment Meets Requirements of Latest Jet and Turbo-Prop Airliners and Virtually All Business-Type Aircraft.*



The growing complexity of jet-prop aircraft, together with ever-increasing demands for improved performance and lower operating costs, has introduced a number of perplexing problems for designers of airborne communications and navigation systems. Available space and permissible weight allowances have shrunk. Needs for improved performance, reliability and dependability have increased. A growing fleet of business-type aircraft, plus increased traffic problems have created a pressing need for communications

and navigation equipment of true value—equipment that is light, compact and dependable. Not only the conventional transport, but the business types as well.

Bendix' new lightweight navigation and communications systems fill these exacting requirements. Units are lighter and smaller. Designed to fit easily and compactly into the tightest transport or the smallest executive-type jets. Complete packages, if desired, to meet your particular requirements. Yet flexible. For the most part these new units are interchangeable and can be integrated with the time-tested and dependable Bendix system now in

## FOR AIRLINE AND BUSINESS AIRCRAFT

use in a wide variety of aircraft all over the world.

Excellent some of the new communications and navigation sets described on these pages. Yet how improved design, rugged construction and maintenance plus rugged packaging are reflected in greater lightness and more compact installations—with superior performance and reliability. For further information and complete specifications write to Bendix Radio Division, Avionics Electronic Products, Balacon 4, Hollywood, Or West Coast—10580 Monrovia Blvd., N. Hollywood, Calif. Export—Bendix International Division, 255 East 42nd Street, New York 17, N. Y., Canada—Communications Division of Canada Limited, P.O. Box 508, Ottawa, Ontario.

**WEIGHT AND WEIGHT REDUCTION**—The following approximate weight reductions are indicated above. Upper half is standard 100 HZ VOR receiver, lower half is new design. Weights are approximate.



Weight of 100 HZ and weight reduction for new design VOR/COM Receiver as indicated above. Upper half is standard 100 HZ VOR receiver, lower half is new design, approximately 100 HZ VOR receiver.

Bendix Radio Division





## Getting specific about gravity!

Falling apples fascinated Sir Isaac Newton. No doubt he enjoyed a few of them while devising his famous gravitational formula. However, astronauts was with what came down, whereas aviation engineers today are primarily concerned with what goes up. Even so, the gravitational challenge is the same.

A jet plane, astronomical missile—or anything else moves—usually leaves the dragg steps too heavy for optimum performance. To be specific—the specific gravity of the material of construction is too high.

Now, with Titanium, the design engineer can cap-

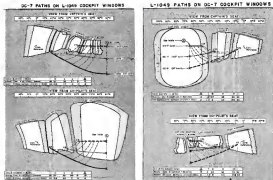
ture the strength of alloy steel at barely one-fourth the weight. What's more, Titanium is unaffected by most corrosion—and is impervious to the daily attack of sea water and marine atmospheres. Its coefficient of expansion is low . . . and it can withstand long-time operating temperatures as high as 1800°F.

All types of Titanium mill products, from foil to seamless tubing, are made by TNCA. With production going up and prices going down, now is a good time to design with Titanium. Technical literature on Titanium is available just by asking.

... FIRST IN **Titanium**



TITANIUM METALS CORPORATION OF AMERICA, 233 Broadway, New York 7, N.Y.



**Table 2** This table lists when both the DC-7 and L-1049 in straight and level and wingspan of about 180°

Wind direction and distance	DC-7 1.5, 2.5, 3.5, 4.5 miles	L-1049 1.5, 2.5, 3.5, 4.5 miles	L-1049 1.5, 2.5, 3.5, 4.5 miles	L-1049 1.5, 2.5, 3.5, 4.5 miles
Approx 1 mi to cockpit location	1.0	1.0	1.7	1.7
Approx distance between aircraft	5.5	4.0	3.5	4.0

**NOTES:**

- L-1049 straight and level and DC-7 in right turn at 180° bank
- L-1049 in left turn at 180° bank and DC-7 in right turn at 180° bank
- Wingspan is set for a 180° bank and DC-7 straight and level
- The paths indicate DC-7 position and relative altitude. Altitude changes rapidly in level 180° turns and occur in the 180° roll-up window
- DC-7 rise at apex of 80° F that occurs between a climb range of 5 to 6 miles and in some positions is parallel approach at 8000 ft
- Maximum climb rate—when climb occurred—was 4000 ft per min
- Clear area is the altitude at which collision—also indicated—can be with both sets
- Clearance time—plus ground clearance—was 400 ft above and to ground level
- Both level ground clearances were on the 1000 ft level
- Complete data on this and other accidents is available in a book

### VIEWS FROM COCKPITS OF Seven Constellation and DC-7 plus reliability of paths of each aircraft as relative to the other.

person were conducted. In the people test it was, at some airports of the Great Canyon Park Service and students of the surrounding forest. During this search an accident was found who are the collapse.

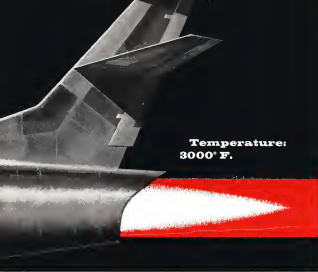
"Although at least one person approached us, similar from the cockpit and observed at a bank bar in the Canyon. Later on July 10, two witnesses saw each other in the third and were called to appear at the public hearing. They were extremely sure that while flying over Bank 60 in front Window and Flight 60 they saw the aircraft outside. They discussed their subject control and especially the Constellation. Both witnesses stated that when collision occurred there was no evidence

such as fuel, smoke or falling pieces and that following impact the aircraft appeared to continue on without falling but level together.

Under intensive questioning, one of the witnesses testified that at the time she saw these two planes she saw them come together, which at the same time she did not see the other side of the time that she had. She stated further that to her that she saw a light, the signal, the door. She was asked if she observed any space separating the two aircraft and she answered "just between the two tails". The witness was asked just the same that two planes could show the face and something about it to her husband. She ap-

plied that she would have had that the tail her husband didn't draw it. She further stated that she didn't recall his husband saying anything to her about the collision. The witness a repeated since, was asked if there had been any thought in her mind that this was a collision, which she had gone to the nearest telephone and made some call to some official body of some authority. She said that the main fact.

Investigators showed that the collision occurred a short distance west of and above the wreckage because approximately 75 mi. from the witnesses. Calculations and visual evidence indicated that at the distance it would be impossible to see the



**Temperature:  
3000° F.**

Dual orifice fuel nozzles control the flow of fuel to the combustion chamber of a jet—hot as a blast furnace! The advanced design and precision manufacture of these nozzles provide optimum engine combustion efficiency. Ex-Cell-O builds such fuel nozzles... along with blades, rotors, actuators, valves, fuel controls, parts and assemblies.

**EX-CELL-O** CORPORATION  
DETROIT 22, MICHIGAN

EX-CELL-O FOR PROVISION **XL**  
Aircraft Division

MAN AND MACHINES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O

impairing physical features of the aircraft and usually impossible to see the aircraft's flight patterns with respect to earth or air, if visible would be extremely deep-sea. The Board does not question the accuracy of these witnesses but believes they must have seen two other aircraft several air lanes to have been operating in this general area. At a considerable distance and at certain angles of observation two widely separated aircraft could well present the illusion of a collision.

#### Full of Smoke

A third witness reported having seen a pair of aircraft in the sky over the Grand Canyon area. This witness was near Winslow, about 50 mi from the accident area, and was also proceeding in a private automobile west on Route 66. The pair of aircraft appeared very high and from a few seconds appeared to fall on a trajectory north and disappeared into lower clouds. This observation may have been the collision but because little detail could be seen it adds little to the investigatory situation, since this claim already clearly established by more positive evidence.

To establish conclusively the sequence of the information offered by these witnesses, Board investigators were stationed about 15 mi east of Flagstaff, the airport was perhaps the nearest witness area indicated by their testimony. On separate days United and Trans World flights flew the proposed routes of Flights 2 and 711, making positive reports to the investigators according to a prearranged detailed plan. These were reported by a CAA instrument observer located with the investigation. Weather conditions on our day were better than those on the day of the accident and on the second day they were equal to or better than the accident day. Results of this work showed that the aircraft could not be seen though their exact positions were known as were the angles on which to light the instrument. Heavy clouds and haze were undesirable. Once a reference path was set and locations were located on it, this was sufficient to determine a course when the aircraft could be seen but it could not be identified as to type or make.

The Board was about to publish its report as the accident area, on February 5, 1951, it was advised of another alleged encounter to the collision. Since this time the witness was contacted, at Flagstaff, as to the observations in a deposition taken by the Board.

In addition, the witness testified that on June 28, 1950, while proceeding to Grand Canyon, he made his observations through the windshield of a Ford pickup truck in which he was traveling alone on Route 66 toward Desert View at a speed of 75-80 mph up a prolonged incline to the east. At the point of observation he was between 1 and 7 mi south of Desert View at 2557 m. south of the extended collision point.

When questioned as to why he did not make public the fact that he had observed the accident, he answered that he did not wish to embarrass himself. Although he had several conversations with persons involved in the investigation of this accident, including Board personnel and personnel

**D & B AXIAL-FLOW BLOWERS**  
SMALL—LIGHT WEIGHT—RELIABLE  
for  
**AIRCRAFT and ELECTRONIC APPLICATIONS**

We welcome inquiries—  
**D & B RESEARCH** DEAN & BENSON RESEARCH, INC.  
18 BOWLING GREEN QUINN NEW JERSEY  
PHONE: BRIDGE 1180

*for Records*

**McEWAN HILL MILLING**  
BUSHY PARK ONTARIO

**McEwan Hill Milling Also Will Help You:**

- Manufacture your advertising
- Letter writing
- The insurance and bank
- By your telephone
- The price quoted—no hidden charges
- Full advice
- Fast up work service
- All details explained

Should mail be a necessary requirement in a well rounded business from a reliable program.

Our extensive recording services a portion of this ad helps in the second column at the same time as they record lists on the left before publication.

Address of the top being telephone to the office around for the McEwan Hill Milling and also on the left writing list. For your convenience, and of our industrial Stock also available.

Write to your copy  
to obtain complete information.

**FOR BETTER BUSINESS  
FLY TO HAMILTON**

HAMILTON MUNICIPAL AIRPORT

**FLIGHTS**

08-24	0000-1100
11-29	1100-1200
12-04	1200-1300

**ADADEQUATE FACILITIES  
FOR BUSINESS AIRCRAFT**

Only 4 miles from Hamilton, Ontario, Canada's largest industrial city. If you are planning Canadian expansion there are over 240 facilities to serve you. Complete information on the airport and industrial opportunities on request.

**HAMILTON MUNICIPAL AIRPORT**  
Mount Hope, Ontario, Canada

# NEW



DIAPHRAGM TYPE

## 6.5 LB. PRESSURIZATION PUMP

New Cornelius Pressurization Pump **Kit** provides dry air free of oil and carbon dust for:

**RADAR PRESSURIZATION**—Most radar units require clean dry, compressed air at 40 psi.

**FAULT SYSTEMS**—The Model 203 Series Pressurization Pump Kit eliminates the need for costly bleed pumps for a complete, independent system.

**CRUISE ROSES**—Ergas breathing is not critical with the Cornelius Pressurization Pump Kit as new design problems are no more easily solved anywhere in the aircraft.

**DRY PRESSURIZED WATER SYSTEMS**—New equipment for aircraft designs will be air pressurized water systems to obtain adequate water supply and out of line operation of aircraft-mounted Purifier purging of system by an alternate heating pump when starting.



The unique, diaphragm type construction of the Cornelius Model 203 Series Pressurization Pump Kit offers several highly desirable advantages not found in other type pumps.

Full output is assured throughout the long life of the unit because there are no pistons to wear. It delivers dry air, free of oil and carbon dust.

Write for detailed information about this new pressurization kit.  
Request Product Data Sheet Number 13.

**THE Cornelius COMPANY**  
110 27th Avenue N.E.  
Minneapolis 21, Minnesota  
Pioneers in the development of Pneumatic Systems for Aircraft.

of the no current involved he did not see and the fact that he had seen the accident said some months later.

The Board has carefully evaluated all of the testimony of the witness and concludes that it has no probative value. Thus, we cannot accept the witness' statement with respect to weather conditions. The sound contains full and complete weather information as determined from weather reports, pilot reports, and its analysis of the tropicographic. This testimony of the witness is in direct conflict with the known weather conditions, as clearly set forth by reliable and exclusive evidence contained in the record of this case.

Second, with respect to the witness' description of the relative positions and identifications of the aircraft, it is unlikely that the witness could have seen them as well as the manner and from the place he described. This conclusion is based upon certain facts which were made by the Board immediately after the witness' deposition was taken and the fact that the witness' observations were made while driving a truck at very high speed.

Under the circumstances, we cannot accept the witness' testimony.

The possibility that both aircraft could have been south of their course, using the 10 minutes of enroute time for time in this instance, is remote. A pilot of extreme competence shows the time to be insufficient to bring the aircraft, especially TWA Flight 2, to a position much closer than 45 mi. to the observed point and therefore close to the known collision position.

The tropical weather station consisted of a General Inc. model 203 Series Meteorological Instrument located at the airport northwest of Las Vegas Nevada. A second low pressure area was located in Nebraska time which a cold front extended southward over northern Colorado, thence eastward through central Utah and Nevada to a quasi-stationary front during the first night of June 26. Although the pressure distribution existed in a southeasterly flow of about 40 mph over northern Arizona, Nevada and Idaho, there was a strong low pressure area in the Los Angeles area and some scattered clouds in areas but well below flight altitude.

The conditions described were reflected in forecasts made by the United States Weather Service and both company weather departments. These forecasts there would be high baric clouds with light sea breeze in the Colorado River area, the clouds become scattered at 5,000 ft. by 11:00. Scattered thunderstorms were expected south and east of a line defined from Denver through Millard Point, and Phoenix. There were expected to decrease in the Arizona and southwestern Utah sector after 0700 but to increase again by 1300. The setting level was anticipated at 14,000 ft. with high wind and turbulence in the clouds. Turbulence to occur turbulence was



Operations engineers Phil Mark and Bob Gerns discuss system failure requirements of the Fairchild-DF transport program.

## OPERATIONS ENGINEERS

Learn more military and commercial aircraft development programs at Fairchild offer challenging career opportunities to operations engineers specializing in these fields:

- PERFORMANCE AND ROUTE ANALYSIS
- APPLICATION STUDIES
- CUSTOMER REQUIREMENT DETERMINATION
- MARKET ANALYSIS
- ECONOMICS

These positions involve projects in the military and commercial fields and range from studies involving transport, aircraft and jet aircraft utilization.

For detailed information write to:

Technical Personnel Representative



**FAIRCHILD AIRCRAFT DIVISION**  
P. O. BOX 134  
HAGERSTOWN 15, MARYLAND  
A DIVISION OF FAIRCHILD INDUSTRIES AND AIRCRAFT CORPORATION



# AVIATION WEEK PREFERRED

CURRENT PAID CIRCULATION <sup>\*</sup> 65,100

CURRENT PRINT ORDER 65,771

**MAKE NO MISTAKE...** Aviation's biggest news today consists of the latest scientific and engineering developments which make possible tomorrow's aircraft. The prime source for this vital information is **AVIATION WEEK**... preferred by aviation's engineering-management men because...

Working to fulfill their "need to know" are 24 full-time editors — graduate engineers and aviation specialists. They possess the technical knowledge and industry experience needed to sort out, analyze and report in detail aviation's significant technical developments when they happen.

Competitive advantage in this fast-paced industry depends on what the latest is learned. **AVIATION WEEK's** fastest publishing schedule in the industry guarantees its readers this advantage.

**AVIATION WEEK's** high-interest engineering-management readership (Contact year total **AVIATION WEEK** representative who would like very much to expand on this point) has led to overwhelming advertiser acceptance... **AVIATION WEEK** carried 4,885 pages of advertising in 1956, 740 more pages than the combined total of the two next highest ranking aviation business publications.

BUY AVIATION'S LARGEST ENGINEERING-MANAGEMENT AUDIENCE

A MCGRAW-HILL PUBLICATION

330 WEST 42nd STREET, NEW YORK 36, N. Y.



# AEROPRODUCTS ACTUATORS

Control J79 afterburners on Convair B-58 Hustler



THE USAF's first supersonic bomber calls for instantaneous control of engine afterburners. That's why four AeroProducts hydraulic afterburner actuators have been specified for each of its General Electric J79 engines.

A novel feature of this AeroProducts actuator is its patented, mechanical synchronization system. Flexible shafting within the hydraulic tubing exactly coordinates linear travel of the actuator pistons insuring instantaneous, positive control of afterburner nozzles. Designed for extremely high-temperature operation, these B-58 actuators are also equipped with stroke limiters to prevent complete closure of the tail cone in the event of hydraulic failure.

Write us your company (circled in 28 page brochure, "Actuators for Aircraft" and new design articles, "AeroProducts Run An Actuator.")

Thinking for Today Designing for Tomorrow

## AeroProducts



To insure optimum performance, actuators must be specifically designed to each individual installation. In every application—both fixed and rotary—piston-to-rod fit provides wear-knowledge and performance resulting from years of design and engineering experience at applying smooth components for the most critical applications.



ALLISON DIVISION OF  
GENERAL MOTORS • Dayton, Ohio

fracture in the shockstruts. These built-up parts were expected to develop to 39,869 ft or higher, protruding through and above the lower structure. Top of the lower shock was anticipated at about 15,800 ft with good visibility above and outside the shockstruts. The position of the case was badly eroded at 15,111 ft (11,100 ft).

Pilot who flew next the cockpit seat had been used in a typical weather after routine flights immediately after the incident conditions. One witness reports proof about 25 mi southeast of the accident site a few minutes after the accident occurred. He stated that there should be a coverage measurement well east of Las Vegas with increasing coverage from Hanes Creek airfield, becoming weak about 20 miles west of General Cannon Village. Coverage at 79,000 ft. In each report, towing control clouds out of which was located near the middle of General Cannon Village and across further east and higher.

He saw no building east of Grand Canyon Village. He estimated the height of face to wind to be about 15,000 ft and stated that face appeared to still be an active jet building stage. He was unable to state the rest of the identification data—direction, length, or width. Below, he said, the top of the shock was approximately 14,000 with low levels just reported as thick haze at the altitude. About 25 miles southeast of the accident site. The option stated that he reported rise of clouds with an indication of a period west and south west of the accident site.

Other pilots flying below the cockpit were the Grand Canyon area a dualist case was to the west. One pilot and three west built in the aircraft with excellent visibility below it. He added that the rain-drops indicated clouds in all directions to the level of the visual display. Though the level he noted in evidence of any appreciable analysis.

### ANALYSIS

The second item of damage previously discussed formed the knowledge by a secondary witness. This secondary witness refers to the right column assembly, the extent and effect of the column damage, and the relative stability of the aircraft at the instant of impact.

The third impact occurred with the DC-7 moving from left to right relative to the L-1049 and with the L-1049 moving to the right and aft relative to the DC-7. Post-mortem physical damage in consideration of location of the damaged components of the aircraft is reported that first contact took place at the outer leading edge of the L-1049 and the left silicon tip of the DC-7's leading structure. The lower surface of the DC-7 left wing struck the upper aft fuselage of the Constellation with considerable force. Without question there was complete penetration of the left wing and destruction of structural supports of the left wing outer panel. At the instant and after the contact continued to pass through, the left wing outer panel was totally destroyed, leaving all major structural components of the wing from the DC-7's main structure. Through this stage the DC-7's 11 propeller reflected a great deal in the rest of the baggage compartment of the L-1049.

The entire aircraft was in a steep climb and in such a manner that an interfering of the aircraft was entirely impossible. From the Constellation wreckage the location of various components on the ground, the witness report upon the first flight of the Constellation was that the pilot did not see the main cabin door of the Constellation open the emergency door. This aircraft was parked down and left on a short forward trajectory to the ground. Consideration of this location only the threat to conclude that the collision occurred in space over a location just west of the TWA crash site.

The United aircraft appears to have been lower level and appeared to be in a steep climb. Most of the left side wing was separated along the column and it appears that the emergency exit door of the DC-7 was struck by some low level of the Constellation. It is also possible that damage to the left wing structural silicon control. It is believed that the DC-7 fell steeply probably on a rising path, to the ground.

For damage to have resulted as described the aircraft must have been in a steep climb, the aircraft must be in such a position as to cause a severe impact to the aircraft. The aircraft must have been in a steep climb and independent of the wreckage of damage, a strike was also made against the propeller area. Each student goes nearly identical results relative to the right between the aircraft at the instant of impact. This angle was found to be about 75 deg relative to the longitudinal axis.

From the layout work matching the aircraft member seen it was determined that the aircraft was about the L-1049's altitude was just as the DC-7 was about approximately 30 deg right wing down relative to the L-1049. This study also is directed to the aircraft's general attitude that the vertical distance between the aircraft at the instant was less than the vertical distance between the two aircraft. The difference in angle was between 15 to 10 deg. It is important to recognize that the aircraft witness described his relative to the aircraft to each other and did not necessarily reflect that orientation with respect to the ground.

Review more components of the aircraft were not recovered and other witness report, it was not possible to determine completely whether or not an aircraft was present to either report before impact. From all first witness reports, there was no evidence of acceleration and from all the evidence surrounding this incident the found between them was none.

Analysis of all the available weather information, including pilot reports, indicates that the forecast conditions for the flight were good. The forecast of the two flights departed Las Vegas and departed through an instrument approximately 100 ft thick to clear conditions to top of the forecast was based on either the forecast to the Los Angeles control area. Through the flight, except for some first level conditions, there was no other forecast conditions and there were no other forecasts.

Clear weather reports have been provided for Las Vegas along the Colorado River to near Hanes Creek but becoming overcast about a few minutes before the accident occurred. The forecast for the proposed route of TWA 3 and DME 113, indicated clouds immediately above the Las Vegas area. Forecast indicated that clouds occurred in banks, they began with some breaks in the Grand Canyon was to somewhat east of the accident site. Forecast indicated that coverage was approximately 15,800 ft, with second level being, the lowest being about 12,000 ft above the ground.

Northwest of Grand Canyon Village is over the western portion of the main Grand Canyon, the first of several scattered look-up level clouds. It appears that clouds have been noticed with other aircraft at 11. The buildings were apparently located in the lower clouds and penetrated through and above them at approximately 15,000 ft. An observer caption described the weather as being in large but at an altitude variable north and length. He indicated it was about over Grand Canyon Village. Pilots below the aircraft saw an evidence of a thin but of dark two-sided a view not seen from the aircraft. It is an early dark, the sun was in the bank. The bank used in the system from above, this is the only one of the aircraft that they were broken in the aircraft but that they were low and scattered. They observed that the second cloud bank could not be out of the Grand Canyon.

From the evidence available for based on all the reports that the weather conditions were at 15,000 ft could not be predicted flight in VFR conditions in the accident was but that damage may have been acquired to movement the buildings while the subject flights touched the area.

### Flights Were VFR

According to company procedures, Grand Canyon was not permitted to fly in VFR conditions without a complete briefing of crews. Similarly, TWA procedures prohibited instrument flight above the flight level of 10,000 ft. The flight was in VFR conditions at the time of the accident. Each company, under the conditions where this accident occurred, briefing required by them to allow to use of flight information, it is unlikely that Captain Green would proceed into instrument weather conditions without a complete briefing that the Grand flight was in the ground area at 15,000 ft. The Board is therefore of the firm opinion based on the weather conditions, and pilot reports, that both flights were operating according to rules permitted by VFR conditions in the conditions reported.

The last portion of the report was the flight information, it was seen the report was given. The report was at 15,000 ft. Although there was not a complete briefing of the aircraft at all altitude in the uncontrolled area, with respect to Air Traffic Control, such coverage did appear that it is worthy of a review. The report was given in the area and no known reason for the flight to fly altitude at a constant altitude at 15,000 ft.

Concluding each flight is oriented to the

## LIQUID ENGINE DIVISION



In polished aircraft, missiles and space shuttles, research studies. Aeronaut General Motors engineers study how gases expand in a rocket thrust separator, and an engine thrust plate.



Whether your interest lies in transport or space, Aeronaut General Motors offers a variety of challenging work projects for

Mechanical Engineers  
Electrical Engineers  
Chemical Engineers  
Electrical Engineers  
Aeronautical Engineers  
Civil Engineers  
Metallurgists  
Chemists  
Physicists  
Mathematicians

**Aerjet-General**

Established in 1952, Aerjet-General is a leader in the development of liquid engines for aircraft and space.

Write: Director of Scientific and Engineering Personnel, Box 2986, Azusa, Calif. or via 19176, Sacramento, Calif.

Practical. These together with aircraft gas flowmeters, it appears that both flight, ducted flow included the use of pressure about 17 mi. or its immediate drag from friction over the wind tunnel occurred. Although there are several possibilities as to which condition has been reached in the case of (1) it is more likely of these results. One possibility is that it could have been caused by manufacturing to provide a more severe test for the passenger, although the evidence is not sufficient to establish the fact. Another possibility is that a low kinetic wind was encountered during the sub-jack separation. This was noted for attempts made toward the progress of the flight. A third possibility is that one or more loadings to the Comet Citation was also here mentioned, suggesting the fact that the

At approximately 1215 the 54th Liaison Squadron was in possession of the last possible report made by each of the subject flights. It was then determined that when the reports were made both aircraft were approaching at 21,000 ft. was an overcast cover, and was obtaining the Painted Board of the same time. The actual nature of the flight of the aircraft is considered a factor of not this should have been done, the traffic control situation, the controller's report data and the responsibility involved to provide the information to flight must be considered.

An Traffic Control controller to assist in traffic when it is appearing in accordance with an IFR clearance and while it is within the radius of controlled airspace. If a forecast weather condition exist and the above requirements are met, all air traffic would be reported. However when visual flight conditions exist instrument traffic is handled with down other like traffic and not from aircraft being down under visual flight rules, each of the latter being as known to Air Traffic Control. For this air traffic as visual conditions are required to provide their own separation regardless of flight plan or clearance.

### Uncontrolled Airspace

Obviously, the controlled airspace for air traffic control except for non-authorized flights is a separation for separation or traffic conditions of flight plan, clearance or weather conditions. In this area no control is exercised by Air Traffic Control, its principal function being to monitor the progress of flights through its controlled area so that it orders them to instrument traffic may be recognized, and the air traffic control area. Control is not provided, available in the controlled airspace by clearances and means do not exist.

At the present time in the volume in formation to flight is observed when and when visual of air traffic is being received. Thus, such advice is distributed with the controller and a communication procedure of control. Accidents and incidents in the instrument category that the controller is informed of the aircraft involved and have been and likely conditions on the part of flight rules to their track and lateral and forward position along a defined track. This information may therefore be passed and used to make observations on other flights to determine whether or not a conflicting situation exists. In the uncontrolled airspace, it is primarily stated

lights on, presented greater difficulty in the advantage of a wind and velocity factor. Further, it is also the instrument on the existing flight to report its position with the pressure received to enable accurate advice information are sufficient. The observational factors affecting the value of traffic advice information are evident in respect to 73A's and United 713. Both flights were observed north of their proposed tracks, both were approximately 1000 feet above their tracks, but estimated that would be of that time and their actual tracks intersected a considerable distance before the proposed tracks diverged. Such divergence are unusual occurrences.

Although knowledge of the subject flight path of the subject flights could have prevented the last later controller to allow both flights traffic advice information as a reference base giving the best reference was making to him at the time, the Board is of the opinion that the existing control concept for Traffic Control policies and procedures and the expert duties of a controller did not require him to do so.

### Went With Pilot

The evidence, to clarify all the radar failures, apparently occurred in visual flight conditions and there is no reason to believe the aircraft were not being operated in accordance with clear separation criteria of visual flight rules. Under these conditions and according to their rules, the vast portion of their track is being controlled. Although, the present means for tracking failures seem with the pilot to see and avoid other aircraft.

Extensive study of most advice was done by them that there was an apparent lack of warning degree for the pilot to see the conflicting aircraft and could have been to help more exact visual to avoid the accident. In some of these accidents, it was stated that the instrument of the pilot was that they were monitoring a control board but despite it, the Air did not see the other aircraft as this is stated in their report.

Current studies including simulated flight tests have proved that using other means in flight is difficult. The degree of such difficulty is variable with numerous variables and attempts being effected it. The first variable factor is the specific height of cockpit vision, in the view should be rugged structure and design and.

The second variable factor is visual range or the distance that an object can be seen. Many conditions and circumstances enter into the factor and are variable. Some of these are color of the object, its back ground, and the weather between them. Other are some of the object's angle and shape, and the atmosphere's refraction of visibility. The latter may also include altitude effect and cloud and vertical.

A third group of factors is photometric or human and may, if state an unchangeable dependency on the individual's visual condition, degree of fatigue, and training. The human eye will best see an object when it is within the center or focal field of vision, which is two or three degrees. An object may be seen through the peripheral portion of vision at the rate of several degrees outside focal field. The number of



s'Gravesande's Stoomwagen

## s'Gravesande's Steam Reaction Car

In 1921 Jacob Willem s'Gravesande of Delft, stimulated by the recently announced Third Law of Motion, organized the Royal Society by constructing a practical steam reaction car. The vehicle actually moved several times its own length, a distance of about two meters.

In 1956 the goal is no longer meters, but hundreds, and even thousands, of miles. Aerjet-General Corporation, leader in American rocket propulsion for more than a decade, is proud to participate in man's first assault on the frontiers of outer space—Project Vanguard.

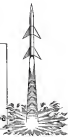
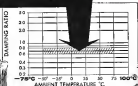
**Aerjet-General CORPORATION**

A Division of **GENERAL MOTORS** CORPORATION  
The General Truck Motor Group      4070A LANSING, MICHIGAN 48106, CALIFORNIA

Aerjet-General invites scientists and engineers—men of imagination and vision—to join the attack on the most significant research, development and production problems of our time.

## CONSTANT DAMPING WITHOUT HEATERS

is readily achieved by the unique design, over the full temperature range, for all altitudes from 70,000 to 100,000 feet.



## NEW MINIATURE FLOATED RATE GYRO

So small!  
(20" dia. x 2 1/2" H.)



Designed to maintain without heater by a novel arrangement that varies the gap between the gyro rotor and stator and a concentric cylindrical stator. The D.B. constant can be set to suit customer requirements within 0.1 of rated.

### MODEL 55,000 CHARACTERISTICS

- SHOCK: 100 G.
- VIBRATION: 35 G. to 2000 cps
- ACCURACY: ±0.5% full scale under severe vibration
- POWER: 100mw. Includes 24K, 400 cycle, inductive pickup with 500 ohm input impedance provides high power signal output for this gyro.
- HIGH SCARF FACTOR of approximately 8 volts per degree enables use of minimum gimbal deflection, permits high natural frequency.
- MOTOR EXCITATION: 125V or 24V 5 phase, 400 cycles.

Write to:  
**GYROMECHANISMS, INC.**  
Hamilton-Getty Corp.  
Belleville, (near St. Louis), Mo. U.S.A.  
for engineering information and quotation of this or other gyros to your requirements.



Solo Offices: Stamford, Conn. • Washington, D.C. • Dayton, Ohio • Chicago, Ill. • Los Angeles, Calif.

degrees is dependent upon motion and/or the dimensional errors present with our system. It may be noted that usually certain known factors concerning collisions (mass) provide an relative motion when viewed from the aircraft. Assuming the aircraft system the relative motion and the stability systems occurring through this level. This system then, the system being fitted to the physical factors and the stability depends on all conditions being including clear speed.

Aimed to the element of approach it is important to recognize that the operation of a modern aircraft requires regular and frequent attention of the pilot or pilot to detect within the cockpit. Attention to a streamlined body presented and design that is required during all phases of flight as well as conventional and visual processing to the progress and anticipated progress of the flight.

Many combinations of adverse factors, conditions, and circumstances can result in a limited opportunity to see another aircraft. On the other hand the opportunity to see another aircraft may be good. The factors set to a good and reasonable opportunity for the flight pilot and the pilot the flight expect pilot to maintain the highest degree of vigilance.

It is recognized that the least common factor, especially in VFR conditions is probably the "see and be seen" philosophy. This concept has resulted in a state of awareness with its lowest limitations and will continue until there are sufficient both integrated factors to provide additional awareness to the pilot for collision avoidance. The program of constant a moving flight toward higher altitudes and greater speeds, with traffic in increasing density, why more of the need to effect the flying a briefing on support to satisfy other governmental agencies and interest in our 1000 and 10000 feet, means, and demands, which will meet this concept of equal operations.

### Inefficient Evidence

Knowing full well that inefficient and slow would provide determining and positive results the existing opportunities for the operation of the flight pilot and the flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

After the creation of the aircraft relative to the ground and the relative flight path, the flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

An excellent combination of the physical factors which are aircraft will depend on the other and the relative motion of the ground. Obviously the physical conditions is not such at the nature of aspect. Because of the fact in the absence of movement of the aircraft, the flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

can determine a single flight path of the aircraft pair in the column, nor is it possible to establish the flight path by other known factors concerning collisions. It is therefore necessary to restrict the analysis on the basis of several flight path conditions. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

### These Features

The first feature means that there was an increase in the relative motion of the aircraft pair in the column, nor is it possible to establish the flight path by other known factors concerning collisions. It is therefore necessary to restrict the analysis on the basis of several flight path conditions. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

The second feature of the flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

The third feature of the flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

It is known that several closed buildings would be the immediate area of the collision and their height structure will also be the causing ability of both flights. Although it is assumed, it is commonly just able that the aircraft may have been down to that one side on each side of a building shortly before collision. The effect of the movement of the aircraft, the flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem. The flight aircraft should be considered as a primary problem.

IS THIS  
your opportunity



Preliminary  
**DESIGN ENGINEER**  
for **ELECTRONICS**

YOU will be asked to develop customer requirements... to forecast production difficulties and costs... and to help estimate the production cost to the customer. You will need a working knowledge of engineering requirements and terminology so that, since you have determined the customer requirements, you can work closely with the design and analysis groups to determine: 1) if the product can be made and 2) if so, how difficult it will be and 3) what the cost of development and cost of item will be to the customer. You should be able to write and express yourself in a convincing, articulate manner.

Twenty-five per cent of your time will be spent traveling, all in the United States. You will receive an away from home for more than 2 or 3 days in this year opportunity! Find out - send a complete resume to

KELL SMITH  
**HAMILTON  
STANDARD**  
Div. of United Aircraft Corp.  
1500 North Main Street  
Windsor Locks, Connecticut



land the last six pilots to see the conflicting reports the accident happened on the size and shape of the cloud. The latest details furnished by the Flight Data Team, and the findings of the study from this information point that a cloud portion would be the critical point to build into which the aircraft appeared to have struck. This information appears to be probably correct and indicates a serious consideration as the visual approach study. To this end several additional cloud size and shape were identified and introduced in the analyzed study. The study also included the consideration which assumed that clouds would not have been a factor. The study accepted as the best of visual range a distance of five to six statute miles and assumed that the aircraft passed the cloud at a distance of approximately 2,000 ft. and that they were at the same altitude.

The results of this analysis were then applied to the individual case examinations from five reverse cockpit positions. This was accomplished in the form of standardized flight decks, assuming the visual reference with the cockpit limits of cockpit range.

#### Captain's View

From the display it is apparent that the L-109 was within the visible limits of the DC-7 window area from the cockpit seat during all of the flight path maneuvers. In the vicinity of an interesting climb maneuver would be involved in those of the two spinners. Windshield frames would block the captain's view for certain portions of this maneuver. The time opportunity with no cloud was 39 to 120 seconds according to the altimeter being displayed. The visual cloud would be in the time opportunity to be as low as 82 seconds.

With respect to the DC-7 last officer position, the L-109 was within the angular limits of the DC-7 window area during all of the climb maneuver and during the rest part of the other two in the "reduced" factor situations. The L-109 would have been most likely to be seen by two conditions without relative motion in one and with relative motion in another. One opportunity would be during the climb and with both aircraft steady and level on 120 seconds. For the other three conditions including the descending climb conditions, the time opportunity would be 120 seconds to 80 seconds.

In this part of the correlation does it appear that the L-109 could have seen the DC-7? The answer is that the opportunity was for a period of up to 40 seconds with an entering climb. In the other three conditions, according to the study, the opportunity would be for the limit of cockpit clearance or beyond the DC-7 to be located visual range.

The study indicates that without the other visual cloud conditions the DC-7 was within range and within the angular limits of cockpit range from the L-109 cockpit's view during three of the four cockpit positions. When the time opportunity was from 100 to 120 seconds according to the situation. Two of the display record relative motion. Again, in the worst case situation, the time opportunity was at least to 12 seconds.

Analysis of the reverse possible flight path variations related to cockpit range during the time of 100 to 120 seconds for both pilots of one aircraft could have been predicted from using the conflicting aircraft data and cockpit position. The study would increase the possible effect if one crew member was equipped with cockpit data and he alone had the visual opportunity during the approach.

#### Clouds in Area

The Board has shown the extensive of cloud-topology done in the accident case. It has shown that these clouds may not have been as extensive factors between the flight data and the accident. His flight information for the pilots to effect visual opportunity was good. In this situation depicts the possible flight path variations and the possibility of other, unexplained factors including visual clarity of the pilots for the Board as the cockpit data was not appropriate to be adequate.

If the situation existed the Board has shown the pilot should have seen and avoided the other aircraft.

On the other hand, evidence has shown that during other of the possibilities the pilot opportunity to effect visual opportunity could have been given as required. Analysis has shown how clouds of mountainous height could have been a factor in the vicinity of 15 or more seconds necessary for scanning, pilot workload and engine response. The Board has carefully studied and thoroughly analyzed all of the available evidence surrounding this accident. It has based all of the findings based on investigation and evidence collected to do. This one case without the assistance of cockpit data is a serious case because it resulted opportunity to a complete knowledge and to each conclusion in the various case analyses.

Because of the lack of the total available data and when all factors including airplane and cockpit range are considered, there may be some doubt as to the accuracy of the Board's findings. It is not possible to determine why the pilot did not see such other, but the evidence suggests that it would have been seen as a result of the following factors: entering climb, cockpit range and visual opportunity, visual limitations due to cockpit visibility, poor cockpit visibility, poor cockpit visibility, poor cockpit visibility with angles associated with each pilot's direction as attempting to provide the program with a visual cloud view of the Clouds in Area. The Board has shown that it has been shown that the visual opportunity to see and avoid the other aircraft or avoidance of an error as traffic alerting information was a consequence of factors and lack of precision as well as defined.

#### FINDINGS

1. On the basis of all available evidence the Board has found that the flight opportunity was for a period of up to 40 seconds with an entering climb. In the other three conditions, according to the study, the opportunity would be for the limit of cockpit clearance or beyond the DC-7 to be located visual range.
2. The study indicates that without the other visual cloud conditions the DC-7 was within range and within the angular limits of cockpit range from the L-109 cockpit's view during three of the four cockpit positions. When the time opportunity was from 100 to 120 seconds according to the situation. Two of the display record relative motion. Again, in the worst case situation, the time opportunity was at least to 12 seconds.

If the situation existed the Board has shown the pilot should have seen and avoided the other aircraft. On the other hand, evidence has shown that during other of the possibilities the pilot opportunity to effect visual opportunity could have been given as required. Analysis has shown how clouds of mountainous height could have been a factor in the vicinity of 15 or more seconds necessary for scanning, pilot workload and engine response. The Board has carefully studied and thoroughly analyzed all of the available evidence surrounding this accident. It has based all of the findings based on investigation and evidence collected to do. This one case without the assistance of cockpit data is a serious case because it resulted opportunity to a complete knowledge and to each conclusion in the various case analyses.

Because of the lack of the total available data and when all factors including airplane and cockpit range are considered, there may be some doubt as to the accuracy of the Board's findings. It is not possible to determine why the pilot did not see such other, but the evidence suggests that it would have been seen as a result of the following factors: entering climb, cockpit range and visual opportunity, visual limitations due to cockpit visibility, poor cockpit visibility, poor cockpit visibility with angles associated with each pilot's direction as attempting to provide the program with a visual cloud view of the Clouds in Area. The Board has shown that it has been shown that the visual opportunity to see and avoid the other aircraft or avoidance of an error as traffic alerting information was a consequence of factors and lack of precision as well as defined.

21,000 ft., TWA 31 was frantically pursued southwest on 11/5, 7/5.

7. The first position report by each flight operator it was at that time of 21,000 ft., entering the Pointed Down line of position at 21,011.

8. The Salt Lake controller possessed both position reports of approximately 10:11, at which time both flights were in extreme visual contact.

9. Traffic control reports were not provided in a controlled manner and as a result in making the Traffic Control instructions and procedures the Salt Lake controller was not equipped to issue traffic instructions, some was issued verbally.

10. A general request with some breaks over 11,000 ft. in the Grand Canyon area.

11. Several controllers holding tracking data, flight level making a turn north over Grand Canyon. Village and other airports north and northeast at the area of the accident.

12. The evidence received it approximately 10:10 to read flight info similar conditions at about 21,000 ft.

13. The collision in question was above a position a short distance west of the TWA's wreckage area, 17 mi. west of an approximately 1/2 mile long, two mile long, the Pointed Down line of position.

14. Under visual flight rules weather conditions it is the pilot's responsibility to maintain separation from other aircraft.

15. To request the pilot to be in each other received it at night of about 25 deg with the DC-7 to the right of the L-109. The DC-7 was pulled about 20 deg right wing down and pitched down 15 deg nose down relative to the L-109.

16. There was no evidence found to indicate that conditions or failure of the aircraft or their components was a factor in the accident.

#### PROBABLE CAUSE

The Board determined that the probable cause of this collision was that the pilot did not see such other as true to read. Under visual flight rules it is not possible to determine why the pilot did not see such other, but the evidence suggests that it would have been seen as a result of the following factors: entering climb, cockpit range and visual opportunity, visual limitations due to cockpit visibility, poor cockpit visibility, poor cockpit visibility with angles associated with each pilot's direction as attempting to provide the program with a visual cloud view of the Clouds in Area. The Board has shown that it has been shown that the visual opportunity to see and avoid the other aircraft or avoidance of an error as traffic alerting information was a consequence of factors and lack of precision as well as defined.

#### FINDINGS

1. On the basis of all available evidence the Board has found that the flight opportunity was for a period of up to 40 seconds with an entering climb. In the other three conditions, according to the study, the opportunity would be for the limit of cockpit clearance or beyond the DC-7 to be located visual range.
2. The study indicates that without the other visual cloud conditions the DC-7 was within range and within the angular limits of cockpit range from the L-109 cockpit's view during three of the four cockpit positions. When the time opportunity was from 100 to 120 seconds according to the situation. Two of the display record relative motion. Again, in the worst case situation, the time opportunity was at least to 12 seconds.

If the situation existed the Board has shown the pilot should have seen and avoided the other aircraft. On the other hand, evidence has shown that during other of the possibilities the pilot opportunity to effect visual opportunity could have been given as required. Analysis has shown how clouds of mountainous height could have been a factor in the vicinity of 15 or more seconds necessary for scanning, pilot workload and engine response. The Board has carefully studied and thoroughly analyzed all of the available evidence surrounding this accident. It has based all of the findings based on investigation and evidence collected to do. This one case without the assistance of cockpit data is a serious case because it resulted opportunity to a complete knowledge and to each conclusion in the various case analyses.

Because of the lack of the total available data and when all factors including airplane and cockpit range are considered, there may be some doubt as to the accuracy of the Board's findings. It is not possible to determine why the pilot did not see such other, but the evidence suggests that it would have been seen as a result of the following factors: entering climb, cockpit range and visual opportunity, visual limitations due to cockpit visibility, poor cockpit visibility, poor cockpit visibility with angles associated with each pilot's direction as attempting to provide the program with a visual cloud view of the Clouds in Area. The Board has shown that it has been shown that the visual opportunity to see and avoid the other aircraft or avoidance of an error as traffic alerting information was a consequence of factors and lack of precision as well as defined.

remained to be done at 15:00, June 10, 1959. Investigators were promptly departed in the interim south headquarters about 15:30 and returned that the wreckage was located in the Grand Canyon. An wreckage box was immediately packed in accordance with the provisions of Section 702 (c) (3) of the Civil Aeronautics Act of 1958, amended.

A public hearing was called by the Board and was held in the Engineering Committee Conference Room, Washington, D. C., on August 1, 2, 3, and 4, 1959.

#### Air Carriers

Trans World Airlines, Inc., a Delaware corporation, is a scheduled air carrier with principal office located at Kansas City, Missouri. It possesses a current electric license and is a member of the Civil Aeronautics Board and is an active operating certificate issued by the Civil Aeronautics Administration.

These airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

#### Flight Personnel

One World Airlines, Inc., a Delaware corporation, is a scheduled air carrier with principal office located at Kansas City, Missouri. It possesses a current electric license and is a member of the Civil Aeronautics Board and is an active operating certificate issued by the Civil Aeronautics Administration.

These airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended. The airlines operate in accordance with the provisions of the Civil Aeronautics Act of 1958, amended.

tells how you can save time and money with Chobert, Automatic Riveting!



Learn how to use the Chobert High-Speed Automatic Riveting Machine in a convenient and safe way. The Chobert Automatic Riveting Machine can save you time and money - all clearly illustrated and described. Fully illustrated and easy to understand. Free brochure with photographs and drawings. Free brochure with photographs and drawings. Free brochure with photographs and drawings.



Chobert Automatic Riveting Machine. The Chobert Automatic Riveting Machine can save you time and money - all clearly illustrated and described. Fully illustrated and easy to understand. Free brochure with photographs and drawings. Free brochure with photographs and drawings. Free brochure with photographs and drawings.

SEND NO MONEY NOW. Please send me your FREE Brochure about Chobert Automatic Riveting right now!

NAME \_\_\_\_\_

TITLE \_\_\_\_\_ COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_

PRESENT PRODUCTS \_\_\_\_\_

SEND INFORMATION  SEND BROCHURE ONLY



## Ruggedized, Precision Potentiometer

**New construction...  
environment-proof  
performance**

Continuously increasing environmental problems create a demand for precision potentiometers that combine the ability to produce high-level performance signals with construction rugged enough to meet the most severe conditions.

Humphrey high-temperature potentiometers perform best in these conditions with unique design features.

Dual construction has amplified and ruggedized internal connections. Removable elements are not hot loaded axially to the frame. Made with high temperature glass insulated contacts for increased load capacities and hand-solded connections to ensure proper pin-to-socket.

New design for the brush carriage holds brushes precisely accurately throughout the length of the resistance element. Withstands vibration at 25G from 20 to 2000 cps without dismounting or excessive noise.

All standard models are guaranteed to operate continuously at 250° F; special models at 300° F and up to 500° F intermittently. Linear resistance can be maintained with no-impact signal levels of more than 400 mV and resolutions to less than 0.001%.



Also see solid top assembly to improve shaft turn torque (see)



Dual construction of the wiper case element to frame gives new ruggedness.



Dual-leaf brush assembly mounted on copper pin, fixed wiper brush covers.

**Humphrey**  
A Division of General Electric

1001 24th St.  
2001 CANN ST • SAN DIEGO 8, CALIF.  
Send full information on pot line.

NAME \_\_\_\_\_  
COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_

should flight 2 to an additional crew when his surface light crew failed.

Harlan Truman E. Anselmino was also killed by the enemy April 24, 1950.

Harlan Beth E. Davis was employed July 2, 1951.

### United Air Lines

Captain Rufus F. Shibley, age 40, was employed by United Air Lines Job 22, 1937 and was promoted to captain November 1, 1950. During his employment he accumulated 18,997 flying hours, of which 3,233 were in the DC-7. He held a valid aviation certificate with among others, currently effective ratings in transport and DC-7 groups. Captain Shibley completed his last first officer flight on the subject aircraft on the subject flight on March 5, 1956. Prior to the subject flight he had a total of 40 hours. Captain Shibley was qualified near the victim aircraft and had flown it on a regular basis since October 1, 1955.

First Officer Kuback IV Harris, age 30, entered the employment of United Air Lines February 7, 1951. He held a valid aviation certificate with among transport and DC-7 ratings. First Officer Harris was captain-qualified on the DC-7. He had a total of 2,480 flying hours, with 190 on the equipment involved. He received a CAA pilot certificate on May 25, 1949, and joined to flight 705 of June 30, 1950, had 151 hours of solo flight time.

Flight Engineer Ernest Fines, age 39, was employed on March 20, 1950, as a co-pilot. He became a flight engineer February 22, 1951.

He held a recently effective aviation certificate with among and engine and prop, and a valid flight engineer certificate. Mr. Fines had accumulated 2,670 flying hours since March 1, 1953, which include all of the company hours effective on regular scheduled. During this time he flew 205 hours in the equipment involved.

Stewardess Nancy E. Kozlowski was employed by the company February 20, 1949. She received a MAJESTIC A Shortcut was authorized September 1, 1953.

### The Aircraft

A Twin World Airways, N 6522C, a Lockheed Constellation model 1049A, (issued a CAA aircraft certificate No. 645) under the heading Serial 1049740, was manufacturer's serial number 4036. The aircraft was placed in service by the company May 21, 1952, and had a total of 10,518 flying hours, of which 1,547 hours were accumulated since the last major overhaul, with a last maintenance check accomplished last prior to flight 2 of June 20, 1956. The aircraft was equipped with Wright engines model W4000C1B-CB1, and Hamilton Standard propellers model 45263 with main rotorcraft blades.

### United Air Lines

N 6522C, a Douglas DC-7, was purchased by United Air Lines January 18, 1948. It bore manufacturer's serial number 44130 and registry number N728. The aircraft had flown more than 15 hours, 1,325 of which were accumulated since its last over-haul.

A last maintenance check was completed before departure of flight 705 of June 10, 1956. The aircraft was equipped with Wright engines model W4000C1B-CB1. The propellers were Hamilton Standard 45263 with main rotorcraft blades.

# SERVO DESIGN and SYSTEM ENGINEERS

We need an experienced servo design engineer to assume a prime responsibility in a new systems activity. Other attractive engineering opportunities are also available in this new program.

Enjoy challenging opportunities in the analysis and design of electro-mechanical servo loops, including laboratory experimentation and system development.

Work with the top men in the field and work the finest test, research and development facilities. New plant being added in suburban Milwaukee as a part of Major, Perennova, Expansion Program.

AC will provide financial assistance towards your Master's Degree. A Graduate Program is available through the University of Wisconsin. —OR—

GM's long-standing policy of demoralization creates individual opportunity and recognition for each Engineer hired.

You will enjoy, as will your family, Milwaukee's "small town" friendliness and metropolitan shopping and cultural advantages.

For interviews, confidential interviews in your area or an invitation to visit Milwaukee we are now giving out our engineering leads and discuss your possibilities, contact:

Mr. Carl F. Reardon,  
Supervisor of Technical Employment

AC the Electronics Division  
GENERAL MOTORS Corporation  
100 E. Main, Milwaukee 2, Wis.

## UNITED IS HIRING 228 FLIGHT OFFICERS

New aircraft included for delivery in 1957 include aircraft immediate expansion of United's Flight Officer personnel. United is coordinating applications now for training classes commencing in February 1956.

See respective locations, complete job information in a United Air Lines Flight Officer. You're paid while training in United's comprehensive Flight Training Center at Denver, Colorado. When you go on line duty you receive \$485 a month—\$515 at the end of your first six months. As you advance, so do your earnings. United also offers a generous retirement program, retirement incentive plan, profit share benefits.

To qualify you need only a commercial pilot's license with 200 hours or more (no multi-engine time required); you must be a U. S. citizen, 20-38, between 5'2" and 6'4" in height, a high school graduate, and able to pass a flight physical without waivers.

Write today for booklet outlining your opportunity for a high-paying career with United Air Lines.

Mr. Richard Scott of Phoenix  
N 6522C 44130 DC-7  
Registration 44130-1049740  
Registration 44130-1049740

Please send me an information booklet outlining the career opportunities in United Air Lines Flight Officer.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

Openings as of May 13

## WHICH OF THESE 18 CAREER POSITIONS at ARMA INTERESTS YOU MOST?

Now long-range projects mean not only challenging, well-loaded creative work, but security and job stability as well. Additional stability features give you all the recent and cultural advantages of suburban Long Island living. Moving almost never happens!

A partial listing follows. Information on every more paid \$800 may be obtained by contacting Robert Bonwell at the address below.

### AERONAUTIC DEVELOPMENT ENGINEER

Perform basic development on transition to new generation aircraft configurations.

### FOOT ENGINEER ENGINEER

Develop structural analyses and coordinate design alternatives and design the structural configuration to meet weight, load and performance objectives. Liaison between structural, electrical, systems and mechanical design and construction.

### WHEEL ENGINEER—ENGINE (DESIGNER)

Design and development of production and test jet airplane wheel hubs, tire disks and landing gear components. Also design and develop landing gear systems and landing gear test procedures. Liaison with development of the aircraft.

### DATA PROCESSING AND ANALYSIS ENGINEER

Develop the methodology, manual data reduction procedures, control the data in computing and processing, or computerize the data and produce the results. Liaison with test and operations departments. Development of test and operations procedures. Liaison with operations data processing, analysis.

### FUNCTION ANALYSIS—FIELD TESTING

Develop manual military systems including test procedures, diagrams, test planning and test procedures. Development of production testing facility development and evaluation of test results.

### FUNCTIONAL ANALYSIS ENGINEER

Develop diagrams on special electronic systems and electronic equipment. Develop test procedures and test procedures. Liaison with test and operations departments. Liaison with operations data processing, analysis.

### SYSTEM DESIGN ENGINEER

Plan and produce electronic systems, test procedures and test procedures. Liaison with test and operations departments. Liaison with operations data processing, analysis.

### TURBINE ENGINE ENGINEER

Plan and produce electronic systems, test procedures and test procedures. Liaison with test and operations departments. Liaison with operations data processing, analysis.

### WHEEL ENGINEER—ENGINE (DESIGNER)

Design and development of production and test jet airplane wheel hubs, tire disks and landing gear components. Also design and develop landing gear systems and landing gear test procedures. Liaison with development of the aircraft.

### WING ENGINEER

Perform overall planning function for wing, fuselage, tail and landing gear systems. Design airplanes in accordance with customer requirements and coordinate and coordinate with other departments. Liaison between structural, electrical, systems and mechanical design and construction.

### FOOT ENGINEER ENGINEER

Develop structural analyses and coordinate design alternatives and design the structural configuration to meet weight, load and performance objectives. Liaison between structural, electrical, systems and mechanical design and construction.

### WHEEL ENGINEER—ENGINE (DESIGNER)

Design and development of production and test jet airplane wheel hubs, tire disks and landing gear components. Also design and develop landing gear systems and landing gear test procedures. Liaison with development of the aircraft.

### DATA PROCESSING AND ANALYSIS ENGINEER

Develop the methodology, manual data reduction procedures, control the data in computing and processing, or computerize the data and produce the results. Liaison with test and operations departments. Development of test and operations procedures. Liaison with operations data processing, analysis.

### FUNCTION ANALYSIS—FIELD TESTING

Develop manual military systems including test procedures, diagrams, test planning and test procedures. Development of production testing facility development and evaluation of test results.

### FUNCTIONAL ANALYSIS ENGINEER

Develop diagrams on special electronic systems and electronic equipment. Develop test procedures and test procedures. Liaison with test and operations departments. Liaison with operations data processing, analysis.

### SYSTEM DESIGN ENGINEER

Plan and produce electronic systems, test procedures and test procedures. Liaison with test and operations departments. Liaison with operations data processing, analysis.

### TURBINE ENGINE ENGINEER

Plan and produce electronic systems, test procedures and test procedures. Liaison with test and operations departments. Liaison with operations data processing, analysis.

Clip the job or job you're interested in and mail, with your confidential resume. No reference contact without your permission. You'll receive a prompt reply, and your copy of "Major Recruiting Clinic with Arma," full of detailed advertising stories from this company.

Mr. Robert Bonwell  
Technical Personnel Dept., A-474  
Defense American Rock Area Group  
Barnwell Hall, Garden City, L.I., N.Y.

# ARMA



# PIPER

OFFERS  
EXCEPTIONAL  
OPPORTUNITIES  
FOR

design engineers

with 3-5 years experience in mechanical or structural design. Experience with control, landing gear systems desirable. Design not necessary. Several untroupled positions open.



graduate electrical  
engineer

Some knowledge of aircraft radio desirable, but not necessary.



You'll enjoy working with a small, growing engineering staff working on a wide range of new business aircraft projects. Excellent living conditions, a paradise for hunting and fishing. Flying privileges. Attractive salary and bonus arrangement. Liberal employee benefits. Send resume or contact Walter Bond, Personnel, Chief Engineer, P.O. Box 6711 Jay, NY 13787.



Send resume and experience statement to: Mr. George S. Callender, Dept. 65-8, Heavy Military Electronic Equipment Dept., General Electric, Court Street, Syracuse, New York.



# PIPER

AIRCRAFT  
CORPORATION  
Lock Haven, Pennsylvania

AVIATION WEEK, May 13, 1957

anyone can  
make claims,  
but here's  
proof

number 4 is a matter of fact

## GENERAL ELECTRIC'S HEAVY MILITARY ELECTRONIC EQUIPMENT DIVISION

offers  
long-range stability

A relative term, after all. And just about every engineering firm in the country can claim stability, from one point of view or another.

But consider the picture at HMEZ. There are three basic facts that prove its truly long range stability.

**ONE:** HMEZ, well-known as it is to be the General, research, and staff division has received its, undoubtedly, a part of the General Electric Company and backed by its tremendous resources.

**TWO:** As HMEZ you become a part of 25 years' unbroken growth in military electronic HMEZ is no "new baby", but so old its work history reaches back without interruption to World War I. Born in the '30's and '40's, its engineers were major suppliers of the advanced electronic equipment needed by our Armed Forces.

**THREE:** Many of HMEZ's military development have direct military applications—and these are only increases in the future. Commercial applications of military equipment and techniques are and will be made by these applications with the same experience in the development and use of such equipment and techniques.

What's more, your personal stability is guaranteed by an exceptionally broad program of life, accident, and medical insurance; paid leave; and promotion and study benefits. And your professional stability is guaranteed by the tremendous variety in assignments, the better-than-average growth opportunities, and the educational possibilities of our 1965 Tufts School Plan.

For a more study at Syracuse University. This is our list of available positions.

If you agree, consider our present openings. We have more than 70 qualified assignments.

WEATHER AND RESERVANCE RANGE & DEFENSE RANGE & DESIGN & CONSTRUCTION AND DATA HANDLING & DESIGN ENGINEERING AND ELECTRONIC EQUIPMENT

### How is our story?

An employee in the position and degree of electrical engineer presenting certain specific data:

1. International analysis of trade practice.
2. Development of industrial analysis to solve the problem.
3. Design of steel tanks to solve the problem.
4. Design of special steel containers used to distill ammonia from air.
5. Production of steel in ammonia and fuel production.
6. Production of ammonia ammonia from their various steel products.

Interested? Then take a few minutes to write us about your background, education, experience, and, most important, your interests. We'll respond promptly.

Write us tonight, attention to: Mr. George S. Callender, Dept. 65-8

HEAVY MILITARY ELECTRONIC EQUIPMENT DEPT.

# GENERAL ELECTRIC

Court Street, Syracuse, New York



## ELECTRONIC ENGINEERS...

become one of the first staff members of RCA's new ENGINEERING OPERATION

at WHITE SANDS

Proving Ground.

The very nerve center of missile electronics!

RCA is new to White Sands! Qualified electronic engineers can now begin a career at a responsible position where the atmosphere crackles with the stimulation of the frontiers in missile electronics. Specific RCA assignments are in missile electronics, ground support systems, on-air guidance and complex tracking systems. Two years, of course. Have you: EE, ME or physics degree, several years' electronic design experience, and used the test-bank work one of these fields?

System and sub-system analysis  
Reliability data control  
Evaluation of new components

Inertial instrumentation  
Equipment control  
Data analysis

Projects will relate to subsystems such as:

PRECISION RADARS      DATA PROCESSING EQUIPMENT  
DIGITAL DEVICES        FIRE CONTROL  
ANALOG DEVICES        DATA SIMULATION

Start at an excellent salary... A full program of liberal benefits gives your income added security. RCA's Tuition Reimbursement Plan will provide for advanced studies. RCA pays advanced income.

### ARRANGE CONFIDENTIAL INTERVIEW WITH ENGINEERING MANAGEMENT

Send complete resume to:

Mr. David D. Brown, Dept. V-102  
Mgr. Engineering Employment  
Radio Corporation of America  
Moorstown, N. J.



**RADIO CORPORATION OF AMERICA**  
DEFENSE ELECTRONIC PRODUCTS

## LEAR

GRAND RAPIDS DIVISION

Manufacturers of precision products for aviation since 1939, Lear is one of the world's leaders in the design and analysis of auto and aircraft control systems.

### GROUP ENGINEER

#### Flight Controls Analysis

To test prop. directed in the systems and analysis of auto static flight control systems in missiles and pilot aircraft. Five years applicable experience required. Advanced degree preferred but not required.

### FLIGHT CONTROLS ANALYTICAL ENGINEERS

To determine the requirements and performance of automatic flight control systems on the latest type aircraft. Two years applicable experience required.

Advanced analysis of complete systems with detailed experience. All rights reserved in combination.

HARRY D. TRIMBLE  
Assistant Personnel Manager

### LEAR

EMPLOYMENT  
100 GRAND AVENUE, N. W.  
GRAND RAPIDS, MICHIGAN

## WHICH OF THESE JOBS CAN YOU FILL?

### COMPUTER AND CONTROL ENGINEERING

- Cyber Development
- Servomechanisms and Feedback Systems
- Analog Computers
- Military Specializations
- Electronic Computers
- Electronic and Transistor Amplifiers
- Network Design
- Inverters
- AC and DC Servo Motors
- Electronic Research
- Fire Control Systems
- Microwave and Radar
  - Modulators
  - Receivers
  - Transmitters
  - Pulse Generators
- Digital Computers and Data Processing

### ELECTRICAL AND ELECTRONIC ENGINEERS

with 2 or more years experience in:

### MECHANICAL ENGINEERS

with 2 or more years experience in:

- Inertial Guidance Systems
- Cyber Development
- Military Specializations
- Servomechanisms
- Product Design and Packaging of Electro-Mechanical Devices
- Fire Control Systems

### NUCLEAR ENGINEERS AND PHYSICISTS

with experience in:

### NUCLEAR SCIENTISTS

- Control
- Metallurgy
- Physics
- Instrumentation

### MISSILE GUIDANCE ENGINEERING

- Cyber Development
- Servomechanisms and Feedback Systems
- Analog Computers
- Military Specializations
- Electronic Circuitry
- Microwave and Transistor Amplifiers
- Network Design
- Inverters
- AC and DC Servo Motors
- Electronic Research
- Missile Control Systems

### Inertial Guidance Systems

- Cyber Development
- Military Specializations
- Servomechanisms
- Product Design and Packaging of Electro-Mechanical Devices

Do you dare tackle tough problems? At Ford Instrument Co., leading the way in challenge is the engineer's prime responsibility. As a result, the engineer who meets this challenge receives the professional and financial rewards his work merits. One qualifies from top high, and we want to be sure you can match the high

standards of our present engineering staff. Our projects are too important and too complicated to trust to casual engineers. What will you do at FICo? That depends on your specific abilities and experience. For details about the challenge, environment, and opportunity at FICo, write Philip F. McGilvery at below address.



**FORD INSTRUMENT CO.**

DIVISION OF SPERRY RAND CORPORATION

21-00 Thomas Avenue

Great Bend City 1, N. Y.



## THE BIG ADVENTURE IN PROPULSION ENGINEERING

Within months the first man-made earth satellite will be launched by Martin.

It is the opening gun for the commencement of the biggest adventure of our time in the field of propulsion engineering. Opportunities in this fundamental area at Martin range from Mach 2 speeds to space systems propulsion, and from nuclear-powered flight to photon physics.

If you are interested in astronautics engineering with tomorrow as the target, we urge you to investigate the inside story at Martin.

Contact J. J. Helley, Dept. AW-10, The Martin Company, Baltimore 3, Maryland.

**MARTIN**  
BALTIMORE

## EMPLOYMENT OPPORTUNITIES

### ELECTRICAL ENGINEERS

*you can help  
put the first  
nuclear powered  
plane in the air*

**at the Aircraft Nuclear  
Propulsion Department  
of GENERAL ELECTRIC**

— think of contributing to one of the most important events in aviation history — helping bring out an engine that has 20,000 megawatts where fuel was measured in pounds per day rather than thousands of pounds per hour.

Yes. A young engineer can make a name for himself here—and he doesn't need previous nuclear training to do it.

If you have from 1 to 5 years' experience—and research knowledge of how to apply your technical knowledge in new fields—you can start work immediately in project areas like these:

- Controls and instrumentation (radio aids, hydraulics, electrical, map aids, servos)
- Fueling (liquid fuels)
- Experimental testing for reactors, turbopump engines and associated power plant equipment
- Avionic electronics

Your operational skills will be fully utilized, and you'll learn new ones on the job—under thorough supervision with extensive contact in nuclear technology as the plant, or graduate study in a 100% tuition refund plan.

**EMPLOYMENT OPPORTUNITIES  
DEPARTMENT**

**RELOCATION EXPENSES PAID**

Circle of two locations:  
Cincinnati Ohio or Idaho Falls Idaho

Write for conditions, salaries and application forms.  
No further cost to you.

Mr. J. E. Escobar      Mr. J. A. Boyler  
P. O. Box 123      P. O. Box 523  
Cincinnati Ohio      Idaho Falls Idaho

**GENERAL ELECTRIC**



**for minds with 20-20 vision**

**T**HE ABILITY to see clearly with the mind's eye is characteristic of most good engineers. Newborn it is more highly prized than even at Goodyear Aircraft.

Our creative engineers are men of talent and training, of course. But beyond that, they are men gifted with an uncanny capacity to look ahead, think ahead and above all, see ahead.

Their materials are the progress of the past. Their genius is the promise of the future.

To hold that promise, our engineers have at their disposal the most modern facilities, including one of the largest computer laboratories in the world. They have unlimited opportunities in the field of their choice—whether it be design, analysis, electronic guidance equipment, structures—or countless other challenging activities.

There are no limits, either, on individual thought, no barrier to the flow of inspiration.

If you have faith in your ideas and confidence in your ability to make them work, a rewarding career can be

found at Goodyear Aircraft. Our continued growth and diversification have acquired expansion of our engineering staffs in all specialties at both Akron, Ohio, and Lakeland Park, Arizona.

You'll find salaries and benefits agreeable. If you wish to continue your academic studies, compressed tuition courses leading to advanced degrees are available at nearby colleges.

For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jones, Personnel Dept., Goodyear Aircraft Corporation, Akron 15, Ohio.

*They're doing big things at*

**GOOD YEAR**

**AIRCRAFT**

The Team To Team With An Airman



*Go Middle-west,  
Young Engineer!*



## FOR THE FINEST JOB OPPORTUNITIES IN THE GUIDED MISSILE FIELD!

Yes, it's a fact. As Bendix Guided Missiles you'll enjoy living in an intensive community centered in metropolitan areas and recreational centers, with engineering job opportunities available in the guided missile industry.

As prime contractor for the widely important Talos Missile, Bendix engineers are engaged in the widest possible range of missile work and enjoy unusual advancement opportunities.

There is no question about it—guided missile engineering is definitely the career and most lucrative business, and, logically, the best future for engineers is working with a prime contractor on one of the nation's most important missile projects.

So that you may investigate thoroughly the many advantages of becoming a Bendix Guided Missile engineer, we

have prepared a three-page booklet giving the detailed story of the location of the various engineering groups, such as design, production and hydraulic, guidance, administration, testing and development, component evaluation, missile wiring, communications testing, test equipment design, system analysis, reliability, and other important engineering operations.

If you'd like to combine the advantages of living in the Middle West and an equal-abled career for professional growth with one of the world's foremost missile builders, just send the coupon today for your copy of the booklet "Your Future is Guided Missiles".

**Bendix—prime contractor  
for the TALOS MISSILES**



Send Please (please enclose 40¢ for booklets, both text and drawings. A booklet may be obtained on engineering opportunities by mail only. Please send me the booklet "Your Future is Guided Missiles".

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_

### PROJECT COST ANALYST OR PROJECT COST ESTIMATOR

Excellent opportunities for men with one or more years experience in Production Control and/or Cost Control of activities in either communications or hydraulic or industrial engineering educational background preferred. Early giving of personal and educational records to:

Midwest E. Young  
Chief of Staffing & Cost Analysis  
Bullis Division  
Vance Aircraft Corp.  
P. O. Box 2267  
Berlin 5, Texas

### FOR RATES OR INFORMATION

Best Classified Advertising.

Contact  
*The McGraw-Hill  
Office Nearest You.*

ATLANTA, 3, 1201 Peachtree Highway  
Atlanta 24-2121  
# 104121  
BOSTON 16, 250 Park Street  
Boston 27-1160  
# 1 104121  
CHICAGO, 11, 530 N. Dearborn Ave.  
Chicago 42-3100  
# 104121  
CINCINNATI, 27, 1833 Parkview Blvd.  
Cincinnati 34-2117  
# 104121  
CLEVELAND 10, 1810 Huron Blvd.  
Cleveland 1-7000  
# 104121  
DALLAS, 3, 12111 Tower Blvd.,  
Suite 600  
Dallas 24-1117  
# 104121  
DETROIT 26, 824 Fordway Bldg.  
Detroit 26-3773  
# 104121  
LOS ANGELES 37, 1155 W. 4th  
Los Angeles 44-8231  
# 104121  
NEW YORK 38, 220 West 42 St.  
New York 44-2000  
# 104121  
PHILADELPHIA, 3, 17th & Locust St.  
Philadelphia 34-2470  
# 104121  
ST. LOUIS, 8, 3611 Olive St.  
St. Louis 44-2497  
# 104121  
SAN FRANCISCO, 41, 4th Post St.  
San Francisco 44-2400  
# 104121

# ENGINEERS

AC OFFERS YOU SECURITY

Our long-standing policy of decentralization creates unlimited opportunities for qualified Electrical, Mechanical Engineers and Engineering Technicians.



DEVOTED TO  
RESEARCH

AVIONICS—MISSILE GUIDANCE  
—JET ENGINE FUEL CONTROLS—COMPUTERS  
—COMMUNICATION EQUIPMENT—CIVIL DEFENSE  
AVIATION—AUTOMOTIVE ELECTRONIC PRODUCTS

All offer you personally appointed specialists that demand investigation to arrange personal, confidential interview in your territory, write today to  
Mr. Cecil E. Sorenson,  
Supervisor of Technical Employment

AC THE ELECTRONICS DIVISION  
General Motors Corporation

Warren 2, Warren # Flint 2, Michigan

AC's new, modern 225,000 square foot, glass-fronted, aluminum plant being built in suburban Milwaukee is another step in GM's Electronics Division's Permanent, Progressive Program.

For a confidential opinion on how YOU can fit BEST in our Changing Program write us today.



"By reason of special training, wide experience and tested ability, coupled with professional integrity, the consulting engineer brings to his client detached engineering and economic advice that rises above local limitations and encompasses the availability of all modern developments in the field where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he costs him."

## SEARCHLIGHT SECTION

EMPLOYMENT OPPORTUNITIES EQUIPMENT (CHECK FOR DETAILS)

# DC-3 & C-47

(CARBO)

As efficient and famous as ever by

# TWA

AIRCRAFT LOW TOTAL HOURS AND LOW TIME

SINCE **TWA** DIVISION  
LEWWARD AERONAUTICAL SALES, INC.  
P.O. Box 225, Miami, Fla. 331

## MADDEN & PLAYFORD

110 S. WASH ST.  
MIAMI, FLORIDA

Aircraft, Inc.

SALES  
REPAIRS  
EQUIPMENT

**DC-4's** passenger & cargo  
**DC-3** 27 passenger "C" TRIM  
**C-46F** passenger & cargo

**C-46D** cargo  
**LODESTARS**  
**TWIN BIRCHCRAFTS**

FOR SALE  
2 Cash 1939 75A CROCKERS  
also 2 Cash 1939 50A CROCKERS  
See listing also under "Other Aircraft" in  
this issue. See also 1939 50A  
P.O. Box 1939 Miami, Fla.

**NAVCO** Limited Firm  
10 South, Wm.  
P.O. Box 11111  
Los Angeles  
A.E.C. Radio Office  
P.O. Box  
Compton, Albany, N.Y.

## DESIGN JET ENGINE CYCLE ANALYSIS

Good engine needs only three good cycle analyses—just good cycle analyses written from aerodynamic principles. This document is looking for a man who would be able to cycle analyze engine in development and to do existing characteristics of all engine components and their inter-relationships.

We will describe standards for cycle analysis, methods of cycle analysis, through analysis and selection of engine engine cycles. In the field of engine cycle analysis, we will describe standards for cycle analysis.

Together with highly qualified aerodynamicists, we will be responsible for the design of engine cycles and selection of engine engine cycles. In the field of engine cycle analysis, we will describe standards for cycle analysis.

Advantages and possibilities of technical cycle analysis will be described.

Please send resume to: **AVIATION WIRE, 11111**  
11111  
11111  
11111

SEARCHED (See for details) 1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS

### HORNBAC

First, equipment, instrument, equipment, 1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS  
1939 50A CROCKERS

### POSITIONS WANTED

Aviation Wire, 11111  
11111  
11111  
11111  
11111  
11111

Aviation Wire, 11111  
11111  
11111  
11111  
11111  
11111

Aviation Wire, 11111  
11111  
11111  
11111  
11111  
11111

Aviation Wire, 11111  
11111  
11111  
11111  
11111  
11111

Aviation Wire, 11111  
11111  
11111  
11111  
11111  
11111

Aviation Wire, 11111  
11111  
11111  
11111  
11111  
11111

Aviation Wire, 11111  
11111  
11111  
11111  
11111  
11111

## FOR SALE DC-3 and DC-4 IMMEDIATE DELIVERY

**DC-3**  
21 passenger standard airline interior with center door, 1030-72 engines

**DC-4B**  
42 passenger folding payload seats, folding lavatories, cargo floor and door, 1930-13 engines, complete airline radio.

Aircraft are presently in our scheduled operation.  
For additional information contact Mr. MIL S. McCLELLY  
**NORTHWEST AIRLINES, INC.**  
Phone WA9ery 4-2966  
1885 University Ave. St. Paul 1, Minn.

SEARCHLIGHT SECTION

*world's fastest  
most complete  
service center*

INSPECTION	OVERHAUL
MAINTENANCE	PAINT - LUB
MODIFICATION	INTERIORS
INSTALLATION	ENGINE CHANGE
INSTRUMENTATION	EXTERIORS

Specializing in C-44 contracts in minimum category DC-4 conversions to C-52. Best systems with a year or more warranty.

**LONG BEACH AEROMOTIVE**  
Long Beach Municipal Airport  
Long Beach, California  
Call GU4-61-63

For Immediate Sale  
**ROYAL GULL AMPHIBIAN**

This Aircraft has been operated exclusively for use at 10000 ft. — 272 hrs. total time — also modification 1.55.

**TIMMINS AVIATION**  
11111  
Miami Airport, Miami

Good directly with owner  
**For Sale—Immediate Delivery**  
42 passenger ex-Aeromarine Night OWLA

# DC-3

Full equipment  
**\$100,000.00**

REAGAN'S CO.  
6000 Airport, Dallas, N. C.  
Miami 4-1000

# C-46F

Available for immediate sale  
"C" TRIM

**AAXICO AIRLINES**  
P. O. Box 575 Miami 41, Fla.  
72 7-1041

**WORLD'S FOREMOST  
LODESTAR  
SERVICE CENTER**

Inspection	Radio
Maintenance	Installation
Instrumentation	Engine Change
Modification	Structures
Repairs	Radio

**WANTED  
C-54-E**

To lease for six months commencing June 1.

Must have:  
1. Overhaul history  
2. Overhaul costs  
3. Overhaul records  
4. Overhaul reports  
5. Overhaul photos  
6. Overhaul photos  
7. Overhaul photos  
8. Overhaul photos

Address: 11111  
11111  
11111  
11111  
11111  
11111

For Immediate Sale  
**LOCKHEED LODESTAR**

Presently in operation use — 1020-58 Engines 240 Hrs. S.O.H. — 4000 Hrs. Total Time.

**TIMMINS AVIATION**  
11111  
Miami Airport, Miami

**Peckers Engineering Corp.**  
Specializing in Aircraft Repair and Overhaul  
11111  
11111  
11111  
11111  
11111  
11111

**RADAR**  
AUTOMATIC PILOTS  
NAVIGATION AND  
COMMUNICATION SYSTEMS





## MORE AND MORE MAJOR COMPONENTS ARE BUILT BY ROHR

For example, instead, stainless steel, honeycomb panel structures are being manufactured by Rohr for the great new B-78 Harrier, built by Convair for the U. S. Air Force.

Today Rohr manufactures over 30,000 airplane parts, included in such major components as subfuselages, elevators, fuselage sections, paramotor systems components, high strength weldments, and stainless steel honeycomb sandwich panels.

More and more, leading air-frame manufacturers come to Rohr for design engineering, for conception, development and production of parts to meet modern flight problems. In many

cases, Rohr engineering teams are actually assigned to the customer's plant, to work with the manufacturer's engineering staff and bring back a full understanding of requirements to be met.

And, of course, Rohr is well known as the world leader in production of ready-to-install power packages for airplanes — including the Boeing B-52, KC-135, 747, Convair 440, Lockheed Electra Propag, Super Constellation, C-130, Douglas DC-7 — and many other of America's leading military and commercial planes.

For the aircraft parts you need, next time look to Rohr.

WORLD'S LARGEST PRODUCER OF READY-TO-INSTALL POWER PACKAGES FOR AIRPLANES



Complete under-wing systems for equipment and testing operations.

ORLA WDM, SAIGONNAM

Airte plants in Riverside, California • Wieset, Georgia • Auburn, Washington

## ADVERTISERS IN THIS ISSUE AVIATION WEEK, MAY 13, 1957

420	AVIATION WEEK, MAY 13, 1957	61	RESEARCH DEVELOPMENT OF
421	AVIATION WEEK, MAY 13, 1957	62	WINGLESS AIRCRAFT DEVELOPMENT
422	AVIATION WEEK, MAY 13, 1957	63	AVIATION WEEK, MAY 13, 1957
423	AVIATION WEEK, MAY 13, 1957	64	AVIATION WEEK, MAY 13, 1957
424	AVIATION WEEK, MAY 13, 1957	65	AVIATION WEEK, MAY 13, 1957
425	AVIATION WEEK, MAY 13, 1957	66	AVIATION WEEK, MAY 13, 1957
426	AVIATION WEEK, MAY 13, 1957	67	AVIATION WEEK, MAY 13, 1957
427	AVIATION WEEK, MAY 13, 1957	68	AVIATION WEEK, MAY 13, 1957
428	AVIATION WEEK, MAY 13, 1957	69	AVIATION WEEK, MAY 13, 1957
429	AVIATION WEEK, MAY 13, 1957	70	AVIATION WEEK, MAY 13, 1957
430	AVIATION WEEK, MAY 13, 1957	71	AVIATION WEEK, MAY 13, 1957
431	AVIATION WEEK, MAY 13, 1957	72	AVIATION WEEK, MAY 13, 1957
432	AVIATION WEEK, MAY 13, 1957	73	AVIATION WEEK, MAY 13, 1957
433	AVIATION WEEK, MAY 13, 1957	74	AVIATION WEEK, MAY 13, 1957
434	AVIATION WEEK, MAY 13, 1957	75	AVIATION WEEK, MAY 13, 1957
435	AVIATION WEEK, MAY 13, 1957	76	AVIATION WEEK, MAY 13, 1957
436	AVIATION WEEK, MAY 13, 1957	77	AVIATION WEEK, MAY 13, 1957
437	AVIATION WEEK, MAY 13, 1957	78	AVIATION WEEK, MAY 13, 1957
438	AVIATION WEEK, MAY 13, 1957	79	AVIATION WEEK, MAY 13, 1957
439	AVIATION WEEK, MAY 13, 1957	80	AVIATION WEEK, MAY 13, 1957
440	AVIATION WEEK, MAY 13, 1957	81	AVIATION WEEK, MAY 13, 1957
441	AVIATION WEEK, MAY 13, 1957	82	AVIATION WEEK, MAY 13, 1957
442	AVIATION WEEK, MAY 13, 1957	83	AVIATION WEEK, MAY 13, 1957
443	AVIATION WEEK, MAY 13, 1957	84	AVIATION WEEK, MAY 13, 1957
444	AVIATION WEEK, MAY 13, 1957	85	AVIATION WEEK, MAY 13, 1957
445	AVIATION WEEK, MAY 13, 1957	86	AVIATION WEEK, MAY 13, 1957
446	AVIATION WEEK, MAY 13, 1957	87	AVIATION WEEK, MAY 13, 1957
447	AVIATION WEEK, MAY 13, 1957	88	AVIATION WEEK, MAY 13, 1957
448	AVIATION WEEK, MAY 13, 1957	89	AVIATION WEEK, MAY 13, 1957
449	AVIATION WEEK, MAY 13, 1957	90	AVIATION WEEK, MAY 13, 1957
450	AVIATION WEEK, MAY 13, 1957	91	AVIATION WEEK, MAY 13, 1957
451	AVIATION WEEK, MAY 13, 1957	92	AVIATION WEEK, MAY 13, 1957
452	AVIATION WEEK, MAY 13, 1957	93	AVIATION WEEK, MAY 13, 1957
453	AVIATION WEEK, MAY 13, 1957	94	AVIATION WEEK, MAY 13, 1957
454	AVIATION WEEK, MAY 13, 1957	95	AVIATION WEEK, MAY 13, 1957
455	AVIATION WEEK, MAY 13, 1957	96	AVIATION WEEK, MAY 13, 1957
456	AVIATION WEEK, MAY 13, 1957	97	AVIATION WEEK, MAY 13, 1957
457	AVIATION WEEK, MAY 13, 1957	98	AVIATION WEEK, MAY 13, 1957
458	AVIATION WEEK, MAY 13, 1957	99	AVIATION WEEK, MAY 13, 1957
459	AVIATION WEEK, MAY 13, 1957	100	AVIATION WEEK, MAY 13, 1957



### ENGINEERS, SCIENTISTS:

### What did they say the best idea you had an?

All Decisions, we talk to hundreds of engineers and many report how satisfying it is when they make a great invention suggestion and are justly rewarded that "idea" are the responsibility of others. Grouping enough, these same companies often tell about "creative engineering" in their reporting jobs. Fortunately the attitude is not typical of most progressive companies today.

We know many companies who encourage and appreciate creative thinking — who know that youth, ingenuity and progress all go together.

Whether you're thinking seriously about changing jobs or not, Decisions can improve your job progressive confidence and at no cost to you. We will send suggestions of your choice (without your name) to the hundreds of top ranking firms — our clients — who say so in the field good men. And, we will enter your name and resume in our unique Decisions Register, which we search daily to find engineers for specific job openings.

### DECISION/INC

Address of the subscriber: *Decision/Inc, 1000 Broadway, New York, N.Y.*

SEND ONE ADVERT COMPANIES WHO NEED YOUR SERVICES. MAIL TWO COPIES NOW.

**CONFIDENTIAL**

Circle 7 Reader Profile

**NAME (LAST/INITIAL)** \_\_\_\_\_

Management Consultant

11401 East Boulevard, Park City, Colorado 8, Ore

**Dear Mr. Bendis:**

I do have good ideas, and I want to find out who needs them!

**NAME** \_\_\_\_\_

**TITLE** \_\_\_\_\_

3015 Westwood

**STREET** \_\_\_\_\_

**CITY** \_\_\_\_\_

**STATE** \_\_\_\_\_

**CONFIDENTIAL**

## LETTERS

### "Sad Hiring Case"

I wish to say "hello" to Capt. Robert Johnson, "How to Hire a Pilot" in your April 1 issue (p. 45). While it is just one of many of the real cases concerned with the hiring of pilots.

I served as Assault Coordinator on M249 for three years and also as instructor pilot on DCA. When I was selected they were told I returned to develop to complete my field work. I had already been assigned an available slot and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

Well, I was not sent back to take care of them. "What Elementary" and I didn't make the grade. It seems that a big letter signed by me was the fact that I have always enjoyed my work and would not want to be available and decided to say "hello" with the return.

As soon as I was informed of the appointment of my contact on the lowest ranked in the program's selected list. Address: 230 W. 42 St., New York 20, N. Y. Try to keep it very short and to the point. Give a precise classification of the pilot and pilot's experience level, but names of military will be withheld on request.

replace the U. S. Government the way they are in military pilots. I spent one solid week on professional and psychological tests after I had been selected for pilot training. I should think that if I was good enough to be selected for military pilot, the GCA would give me thousands of dollars plus a year's training. But I should be qualified to run pilot's program; general school in that I might be able to get paid for one of these old facilities up there as it must fit it had to live up with the money.

Steve Paul

### GCA Crash Role

Your article about "GCA's Crash Role" in Volume 7, No. 3, March 1972 (p. 11) giving the bill of the British Accident Investigation Board on the Vulcan crash, together with Major Leitch's letter to the editor (EMF April 28, p. 44), was very enlightening. GCA equipment, however, is not the fault.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

The GCA equipment is not as good as that in Great Britain as the 1964 MF90. The GCA equipment is not as good as that in Great Britain as the 1964 MF90.

for the U.S. Air Force, the U.S. Navy, the U.S. Marine Corps, the U.S. Army, the Royal Canadian Air Force, the Royal Australian Air Force, the British Royal Air Force, the Japanese Self Defense Force, the Dutch Royal Air Force, the British Royal Navy, and all of the NATO member, including many other countries around the world.

As an expert in aviation electronics for an Air Corps, an Air Force general, who is a member of the GCA board, I would have increased the meeting by allowing that electronics personnel in aviation will call weekly meetings. The meeting to coordinate electronics equipment design and production in RFM II is really a tactical aviation personnel. We developed F-16s, F-4Es, F-15s, F-16s, Sp5s, F-16s, etc.

GCA has established a superb reference record during the past 14 years and will only need to maintain a history of what new models get built only if suitable GCA equipment is provided to them. When the GCA operator and the GCA maintenance staff.

LEONARD DAVID COLLETT  
Vice President  
Electronic Data, Inc.  
Los Angeles, Calif.

### SPCA for Passengers

As a passenger who has suffered considerable discomfort as a result of motion being prevented from the seat, I would like to suggest that the SPCA be installed in the following case of an active airline passenger and his immediate family. The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

The SPCA is a small, portable, self-contained unit, which is installed in the cabin of the aircraft and is operated in the same manner as the SPCA.

# 400 cycle power

for  
research,  
quality  
control,  
and  
pre-flight  
checkout

Accurate device output demands accurate power input, and in 400 cycle equipment—vital in today's aircraft and missiles—accuracy is everything. For the precise input power needed in designing, manufacturing and checking out of modern avionics systems, it's a growing habit to buy LEACH (INET-Palmer) 400-Cycle Power Units... complete packages, ready to "plug-in."

Every LEACH (INET-Palmer) 400-cycle unit is designed as a system, with both rating equipment and negative-feedback controls developed under one, coordinated program, development and manufacturing procedure. The result... precision and dependability beyond what today's planes and missiles actually call for, operating characteristics ready for electrical and electronic demands set on the drawing boards.

There's a LEACH 400-cycle motor-generator set for virtually every application where regular line power must be changed to clearly regulated, stable 400-cycle frequency. These standard models store the same high electrical performance standards... only the physical arrangements are varied for maximum utility...

STANDARD PERFORMANCE SPECIFICATIONS... all models

Output Voltage ..... 3-phase 3 to 225 0-60 0 5 PF  
1-phase 3 to 25 0-60 0 5 PF

Output Voltage ..... 115/208/220/208, 3-phase, 4-wire  
115 or 120 single phase

Input Voltage ..... 440 volts, 60 cps, 3-phase 225 or  
220-440 or other

Overload Rating ..... 150% for 3 minutes

Efficiency ..... 48% up to 60 cps with 4 to 25 cps output  
frequency ..... 1% to 5% (optional)

Recovery Time ..... 10 to 200 - 150 sec.  
30 to 100 - 200 sec.

Weight ..... 60 to 300 lbs - 250 lbs

Output Type or Overload ..... less than 1% S.F.  
Output Modulation ..... less than 1% S.F.

Efficiency Modulation ..... less than 1% S.F.

Power Factor ..... 45% max. unless deviation from  
the average with non-linear loads can be  
taken into account as desired

Warranty ..... 12 months - 250 hrs total hours output

Base Range ..... 100 - 250 lbs. including field  
work scope

Complete specifications are listed in LEACH's new  
booklet on 400-cycle motor-generator sets. Get for  
your copy today.



FOR THE RIGHT LINE... Completely portable, self-contained unit... available, reliable, accurate and stable, capable of delivering steady loads without loss of accuracy... come thus a month for the accuracy demands by today's and tomorrow's electronic systems. Delivered in various from 3 to 320 KW (2-phase).



FOR THE PLANT... Grounded electronic line... 400-cycle generator... available in various from 30 to 180 KW (2-phase).

FOR THE LABORATORY... Compact, self-contained units... available in various from 30 to 180 KW (2-phase).

# LEACH CORPORATION / INET-PALMER DIVISION

4401 S. SANTA FE AVE., LOS ANGELES 38, CALIFORNIA  
DISTRICT OFFICES AND REPRESENTATIVES IN FEDERAL CITIES OF U. S. AND CANADA

# shooter 1957



Supersonic interceptors are a far cry, as weapons go, from the famed Kentucky Long Rifle. Yet, rifle and aircraft have much in common—both were designed to be extremely accurate and reliable, both were designed to protect America's frontiers.

The Convair F-102A is an excellent example of modern day teamwork and illustrates to full advantage the Weapon System concept of the U. S. Air Force. The aircraft is built by the Convair Division of General Dynamics Corporation, and contains a Hughes Aircraft Company armament control system, which utilizes a Master Data Computer developed and produced by Servomechanisms, Inc. We are proud to be on this team.

## THE MASTER DATA COMPUTER

The only practical way to meet the challenge of increased aircraft complexity, SMI's Master Data Computer senses temperatures, pressures, acceleration and other basic data; computes; and integrates them to provide vital control inputs for aircraft's navigation, fire control, flight control and other systems.



**SERVOMECHANISMS**  
**SMI**  
INC.

**SUBSYSTEMS GROUP**

PLANTS: WESTCHESTER, CALIFORNIA • HAWTHORNE, CALIFORNIA • WESTBURY, L. I., N. Y. • GARDEN CITY, L. I., N. Y.  
GENERAL OFFICES: 12500 AVIATION BOULEVARD, HAWTHORNE, CALIFORNIA

The products of SMI are available in Canada and throughout the world through Servomechanisms (Canada) Limited, Toronto 15, Ontario.